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EDITORIALS

More Basic Research in Farm Buildings Needed

THE problem of buildings that will meet the housing and storage needs, more adequately in every respect, of the farms of America, has always been an important one, though it has received far less consideration than its relative importance merits. Now, however, and to a large degree through the efforts of agricultural engineers, it is beginning to receive more widespread and serious attention by all groups interested in the welfare of farm people. In Mr. Malcom's letter to President Kable, reproduced here, an important aspect of the general problem is touched upon which is particularly the concern of agricultural engineers:

Mr. Geo. W. Kable,
President, A.S.A.E.

Dear Mr. Kable:

At the recent annual meeting of the American Society of Agricultural Engineers, you asked for comments on the work of our Society in general.

During the past four years my work has brought me into contact with the representatives of a number of industries that are closely related to agriculture. Naturally I have heard many comments on our Society, most of which have been good. However, there is one criticism which has been quite general, that is, lack of basic research.

Manufacturers of farm equipment and buildings feel that agricultural engineers have not given enough study to obtaining basic facts. These manufacturers point out that unless they know what the farmer actually needs, they cannot design products to meet his requirements. Many fabricators do not have the time or trained personnel to carry on fundamental research, but they say that the opinions of agricultural engineers consulted sometimes vary so widely that they can be classified only as opinoin — not facts. An example of this can be found in the field of activity represented by the Society's Farm Structures Division. Practically every college has a bulletin on each of the major farm buildings. The requirements set forth in these bulletins vary greatly and sometimes are in direct conflict.

That these facts can be established has been proved by the U.S.D.A. Bureau of Agricultural Chemistry and Engineering in its grain storage studies. Before this work was started, everyone had his own ideas on the proper type of storage bin. As the result of the U.S.D.A. studies, with which the manufacturers cooperated willingly, the requirements of a grain bin have been standardized to a large extent. This is one thing that helped the CCC to purchase the 1940 bins for approximately $1,500,000 less than the 1939 bins, that is, figured on the same total capacity.

In other words, the manufacturers are finding out what is essential in building a storage bin and what is nonessential. The work has not been completed, but it has already paid big dividends.

There is a growing need for a committee of some kind to check all bulletins published by the various agricultural engineering departments for the purpose of keeping to a minimum the number of statements which do not coincide. The various regional farm building plan services are a step in this direction. However, these services seem to be inadequate in view of modern developments such as prefabricated buildings and other structures marketed on a national scale.

Many agricultural engineers and manufacturers also feel that it would be wise to urge the colleges to devote more of their limited funds to basic research studies and carry them through to completion. By this they mean that, instead of six colleges studying poultry houses, let each devote its time to one building and reach a conclusion rather than each doing a part job on all buildings. Greater cooperation among colleges even with their present setup would be a big step in the right direction.

The foregoing are just ideas that have been given to me, but I thought you would find them interesting. I realize that there are many things which would make these ideas rather difficult to carry out. However, perhaps something could be worked out which would make the efforts of the agricultural engineering group more helpful to manufacturers. This in turn means better service to American farmers.

D. H. MALCOM

Manager
Agricultural Markets Dept.
American Rolling Mill Co.
August 9, 1941

Industry and University Cooperate

IN THE news section of this issue is an announcement of the dedication of a new research dairy barn at the University of Wisconsin, which illustrates the possibilities of cooperation between agricultural experiment stations and manufacturers of farm equipment, building materials, etc., in the solution, through research procedure, of problems the final objective of which is to cut down overhead in farming operations, to increase farm income, and to provide the farm family with comforts and conveniences to which they aspire.

Agriculture as an industry is dependent mainly for research, which is so essential these days in the progress of all industry, upon the agricultural experiment stations and those manufacturing industries that look to agriculture as a market for their products. There are many opportunities for cooperation and collaboration between these two great agencies in bringing to fruition the benefits to be obtained from research. For example, in his talk at the dedication of the new research barn, Stanley A. Witzel of the Wisconsin agricultural engineering staff, stated that the barn is designed to give the dairy cow an opportunity to tell how she prefers to be housed for most efficient production, and that it is hoped the results from this research may become the basis for the design of future dairy barns.

To meet farm requirements in the most effective manner possible, manufacturers of equipment and material still have much to learn, although great progress has already been made in general, and especially in certain lines. But if agricultural-engineering staffs at state institutions by cooperative effort obtain a better concept of the manufacturers' problems and point of view, they will be better able to direct their research and investigation so as to furnish the kind of information and data that is basic to the efforts of manufacturers to come nearer to meeting farm requirements in the things they produce. Every agricultural engineer whether employed in public service or private industry, knows that cooperative research activities have been too few in the past, that there is almost unlimited possibilities in this direction, and that they will result in untold benefits to agriculture.

The success of agricultural engineers and the advancement of agricultural engineering can be much enhanced through greater efforts to bring about more and still more cooperation between industry and university.

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Some Important Farm Machinery and Soil Conservation Relationships

By M. L. Nichols and R. B. Gray
FELLOW A.S.A.E. MEMBER A.S.A.E.

THE PURPOSE of this paper is to present some of the important relationships between farm equipment and soil conservation. A presentation of these relationships should help develop that understanding between those primarily interested in farm machinery and those engaged in conservation work, which is necessary for intelligent and sympathetic cooperation.

Some Economic Considerations. Under our system of free enterprise conservation must be practiced under land-use systems which yield a satisfactory return to the users. Soil conservation must be attained without lowering the standard of living of the farm operator. The operator must have a choice between exploitive and conservative systems. If the farmer or rancher cannot make a reasonably good living under a conservative system, he will continue to exploit his land until it is destroyed. In some cases, in order to practice conservation without lowering income, size of farm or ranch area must be enlarged or reduced; in others, rather substantial changes in cropping systems may be called for. However, in most cases throughout the country a reasonable standard of conservation can be attained by the application of relatively simple agronomic and engineering practices. In some areas, such as the "dust bowl", these measures must be supplemented by general adjustments of land use, but in by far the largest portion of the country simple combinations of practices for soil stabilization will suffice.

The high standard of living of the American people have been made possible largely through the development of efficient methods of production. The farm machine has been an important factor in this development. Some maintain that this efficiency has been one of the main factors in destruction of the soil resources. They evidently do not realize that rapid wasting of soil was going on in New England and on the eastern seaboard before large equipment was developed. It has been conclusively proved (by letters from Dr. W. C. Lowdermilk during his visits to European countries) that the destruction of entire ancient civilizations through erosion occurred before agriculture was much beyond the crooked-stick stage. Erosion has occurred both on a 100-acre farm tilled by one man and on one acre farmed by a hundred men. Efficiency in production is not the cause of erosion, and it is high time we corrected this false conception in the minds of some of our leaders.

Paper presented before the Soil and Water Conservation Division at the annual meeting of the American Society of Agricultural Engineers at Knoxville, Tenn., June 1941. Authors: Respectively, assistant chief (in charge of research division), Soil Conservation Service, and chief, division of mechanical equipment, Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture.

Power equipment can reasonably be defended from the charge that it has caused erosion, although in some cases it has been improperly used. If it is argued that power equipment is to blame, rather than those who improperly use it, then we could just as plausibly argue that we should electrocute the gun for murder, not the murderer. Just as the gun is the best defensive weapon against murder, so power equipment offers the best means of defense against erosion. Certainly the farm equipment industry and the technicians and scientists connected with it have a definite and large responsibility in connection with erosion control and water conservation. Because the American people will not reduce their productive efficiency, we have a real job in adjusting our machine practices so that conservation can be attained without material loss of this efficiency.

Some Fundamentals of Conservation. It is necessary to point out a few facts as a basis for understanding the machinery studies just getting under way. Erosion is initiated by the great force of the rain drops as they strike the surface soil. The total force expended by a heavy rain is tremendous. J. Otis Laws (according to unfinished data) calculates that the velocity of falling rain is 20 mph (miles per hour). Two inches of rain on an acre then would have 194,900,000 foot-poundals, or 6,000,000 ft-lb of kinetic energy. This is enough energy to raise a 7-in layer of soil a height of 3 ft over an area of one acre, at one time. Fortunately this terrific energy is dispersed both from point of time and space, but it still is extremely important. If the soil is ex-

posed, it may be packed by this force and, if in condition to be eroded, some of it is churned into suspension. The heavier parts are left by settling, but the finer portions are carried away by water. Obviously surface protection by vegetal canopy or other means is necessary.

The most common means, other than live vegetation, are plant residues used as mulches or incorporated on or near the surface as organic matter. The microbiological complexes associated with these residues hold the soil particles together in aggregates. Such surface protection materially increases infiltration of water into the soil, and the residues protect the soil against evaporation. The rainfall remaining after infiltration and the filling of surface depression runs off. The potential energy of the excess water is changed to kinetic energy of flow, which is the second large force causing erosion.

The whole problem of erosion control by water may then be reduced to (1) the protection of the surface against raindrops, (2) the infiltration of water into the soil and its regulation therein, and (3) the conducting of the excess water from the area in such a fashion that the erosive force of this water is always less than the resistance of the surface over which the water is flowing. In actual practice these problems can be met by plant cover and use of residues in the first instance; subsoiling, subsurface drainage, and the combination of tillage practices, including use of residues and supplemental structures or practices, such as contour furrowing or other levee-like device, in the second; and some intercepting systems, such as terracing, with protected outlets, in the third. While these principles seem simple, the complexity of conditions calls for much study and many departures from present practices. These departures from general practices require much careful investigation before such practices can be safely recommended to farmers.

Machinery Relationship. The best understood, or at least the most discussed, machinery in conservation work is terrace-building equipment. Many sizes and kinds of terracing drags or blades, in addition to plows and terrace wings, rotary terracers, and elevating graders, and various harrows and disk plows, are on the market. This equipment has been and is being successfully used. The ordinary slip scrape and fresno is also proving quite efficient. There have been many techniques developed for these implements, and many men have become skillful in their use. Maintenance of terraces has been found of extreme importance, and systems of plowing and preparation now make a terracing system a permanent part of the farm. Although the knowledge and practice of contour furrowing have lagged, substantial progress has been made in the last few years.

The basin or damming lister is now attracting much attention, because in certain regions of low rainfall it has proved to be a good investment. Not all agree as to the conditions under which this implement can be used, but there is no doubt that it should be used under certain climatic and crop conditions. Cultivators with damming attachments are being developed, and these have shown good results in some places.

Contouring, however, is the most extensive water conservation practice. It is being used all over the United States and in most all cases is proving of great value both for water and soil conservation. Usually contouring is associated with terracing systems, the terraces being used as a guide for the laying out of the contour rows. Contouring in itself involves many machinery problems, including ways to prevent side slippage and ways to properly guide the implements on the steeper lands. In some cases it is advisable to cross terraces at slight grades so that multiple-row equipment can be used more easily. On lands of gentle slope this practice has been quite successfully used.

Because there is little erosion on grass or dense-growing crops, except for periods when they are just becoming established, the problem of practical erosion control narrows itself down largely to areas where cultivated crops such as corn, cotton, tobacco, and potatoes are grown. There is ample evidence that a small amount of surface litter gives considerable protection against erosion, as well as increasing moisture absorption and decreasing evaporation. The problem is how to protect the surface soil by mulches and plant residues and still retain the advantages of cultivation. In a large part of the United States erosion evidence indicates that intercepting terraces must be used in combination with residues; the terraces intercepting the run-off thus reducing the hydraulic force of the water and the residues used as mulches protecting the surface.

We recognize, of course, the possibility of complications in the use of residues due to an increase of harmful insects and to nutritive deficiencies resulting from unbalancing carbon and nitrogen contents of the soil, but we believe these problems can be solved. The problems we are concerned with at present are mechanical ones. How can we grow corn and cotton and maintain a surface mulch for protection? How can we plant and cultivate with the residues on the surface? The subsurface blade, the rod weeder, the specially designed sweeps, and other commercial tools, which operate on this subsurface tillage principle, are al-

(Left) A four-row tractor cultivator in a thrifty stand of cotton planted on the contour. With this outfit a man can cultivate 50 to 65 acres of cotton or corn a day • (Right) Terraces in Sudan grass on the federal soil conservation project near Spartanburg, South Carolina

ready being sold quite extensively. We have plenty of evidence both from our research institutions and field experience that we are not on a blind trail, but it is our responsibility as research workers to perfect these practices with many crops and under many conditions before we advocate their general use.

Never in history has a permanent agriculture been conducted with such a predominance of clean-tilled crops and under so violent a climatic situation as in the United States. Our main crops — corn, tobacco, potatoes, and cotton — all expose the soil over long periods to excessive erosion. We feel that the agricultural engineer is in a position to make another major contribution to American agriculture.

Program and Objectives. The scope of this work can be visualized by noting the number of acres in the several crops mentioned above and taking into consideration the many problems likely to be encountered in these different types of farming.

According to Department of Agriculture statistics about 86 million acres of corn were harvested in the United States in 1940, of which about 76 million were harvested for grain. A part of this crop was cut and shocked, leaving probably some 70 million acres on which the stalks were left standing. About 1.5 million acres of tobacco, 3 million acres of potatoes, and 24 million acres of cotton were harvested in the same year. Practically all of the land on which these crops were grown suffered from erosion, the amount of injury depending on soil slope and climate. However, this land can be protected so that much of the erosion will be prevented and the moisture will be conserved, provided that suitable methods and equipment become available to perform the necessary field operations.

On level land the problem is not so acute, but even here it is desirable to protect the soil. Where corn and other crops are grown intensively over large areas, the residues may be removed from the fields for industrial utilization. Under this condition other means of protection must be found.

SUBSURFACE TILLAGE OFFERS GOOD POSSIBILITIES FOR SOIL AND WATER CONSERVATION

On the land in this country where 53 million acres of wheat, 33 million acres of oats, and 20 million acres of other small grains are grown, the erosion problem is usually not so serious. However, the pioneer work with residues, which was carried on primarily as a moisture-conservation measure, was done mainly with these small grain crops. The results of studies at Lincoln, Nebraska, reported by F. L. Duley and J. C. Russel, indicate that the subsurface method of tillage is very successful in increasing the rate and amount of water infiltration into the soil, lessening run-off and controlling soil washing.

On sloping corn and cotton land erosion is serious, and it is desirable to leave as heavy a covering of litter as possible on the land. The problem of performing the necessary field operations with the residues on the surface is one that will require considerable ingenuity in its solution.

Trash or plant residues complicate every operation, and the work has been divided into three parts, namely, (1) preparing the seedbed, (2) planting, and (3) cultivating.

Of course, a sound crop rotation designed for soil building and maintenance must be followed. If oats follow corn, the corn stalks should be broken down and the oats drilled in. However, when corn is to follow corn in a field which has been hand or machine picked, it is more difficult to handle the residues. Before the field is planted it should be disked and the stalks rolled and broken down.

Ordinarily when corn follows corn, the ground is plowed and most of the stalks turned under before harrowing and planting. Under the proposed plan, with the stalks remaining on the surface, a new type of implement may be necessary to till the soil underneath the surface trash. Harrowing would hardly be possible and probably unnecessary, if the planter were equipped with a runner and an attachment for tilling the soil only in the place where the seed is to be planted. This practice has been used for cotton for many years by at least a few farmers. It has been found that a disk blade just in front of the planter runner will cut through any stalks which may lie across the path of travel. Possibly difficulties would be minimized if planting were done parallel to the stalks that have been rolled down.

Ordinarily, corn is cultivated three or four times. In the subsurface method possibly fewer cultivations may be necessary because of the deterrent effect of the plant residue on growing weeds. It should be borne in mind that our soils were all developed by the decay of organic matter on the surface. The proposal, therefore, follows natural processes.

SUBSURFACE METHOD OF FARMING CREATES SOME NEW EQUIPMENT PROBLEMS FOR ENGINEERS

The problems involved in this method of farming leave a large opportunity for the ingenuity of the agricultural engineers. Attachments devised for existing equipment may be all that is necessary, or it may be necessary to develop new equipment, which may or may not be used in conjunction with the old equipment. At any rate the agricultural engineers have a large field to work in and, as in the past, will come through with unique devices to meet the new situation.

The program as now established calls for studies at the laboratory and in the field. At the tillage laboratories the effects of the covering, treatment, type, and condition of soil, as well as the effects of tillage tools on infiltration, run-off, and puddling will be studied. In order to accomplish this phase of the work lysimeters are being built at the U.S.D.A. Tillage Machinery Laboratory at Auburn, Alabama, where certain crops, such as corn, cotton, small grains, and legumes, will be grown in rotation. The effect of the use of different tillage tools, some of which have been specially developed, will be studied. The experiments will be carried out on several soil types under controlled conditions.

In the field, work is under way in Nebraska, Alabama, North and South Dakota, Georgia, South Carolina, Iowa, Maryland, Maine, Montana, and Idaho.

Men of many different skills are working on this problem — engineers, agronomists, soil technologists, microbiologists, and physicists — and the solution of its many phases depends on the hearty cooperation of all. With such a group coordinating their efforts, a new system of crop production may emerge as different from the agriculture we now know as the horse is different from the automobile or tractor.

EDITOR'S NOTE: As the authors of this paper state in the closing paragraph, the complete solution of the problem of subsurface tillage and utilization of crop residues as a combination soil and moisture conservation measure, requires the very best cooperation and coordination of effort of men of many different skills. Agricultural engineers are much interested in this problem, not only in the engineering involved in the soil and water conservation aspects of the problem, but also in the development, improvement, and application of farm implements and machines that will meet the requirements of this new method of farming—*and* agricultural engineers are first-class cooperators!

Architectured Homes for American Farms

By A. Clark Hudson

MEMBER A.S.A.E.

THERE are many problems involved in providing adequate rural housing, economic and social as well as technical. A farmer cannot build a new house or remodel an old one if he does not have the money. Neither will he build or remodel unless he is convinced that by so doing he will obtain worth-while returns and improve living for himself and family. Yet even if he has the desire for better housing and the money necessary to obtain it, he still needs the advice and assistance of architects and engineers, the technically trained men responsible for the finished product. They determine how well the house satisfies the conditions it was intended to meet.

The farm home is a basic member of our national structure. It houses the basic family of our society. It is the basic unit of our architecture. America's first houses were farmhouses, and for generations they have been an expression of the life and culture of the people who lived in them. From the "salt box" of early New England and the colonial mansion of the Mississippi plantation to the ranch house of California and even the typical one-room mountain cabin of Tennessee, rural architecture has typified and been an integral part of the culture and environment of the people. Each type was developed to meet certain definite needs and was successful in proportion to how well it met those needs. If we are to accept the challenge of today's needs and keep our farmhouses abreast of the times, we must develop a new and vital rural architecture.

Because of misunderstanding as to the fundamental principles of architecture, many people do not consider it a necessary factor in farm housing. They think of architecture not as the fundamental art and philosophy of building and as a reflection of the needs of the people but in terms of skyscrapers, banks, churches, schools, public halls, and fine residences. They think of farmhouses as just plain houses where plain people live. That these plain houses are usually unattractive and uncomfortable is accepted as a matter of course. It is seldom realized that the principles of good architecture are just as applicable to the farmhouse as they are to the office building. It is not only possible, but most important that these principles be applied in developing more satisfactory farmhouses and in raising the standards of rural living. It is only by their effective coordination with other factors that vital and fundamental results will be obtained.

Without undertaking any general discussion of architecture, it is desirable to mention briefly a few of the basic principles of good design that find application in the planning of better farmhouses. These are not new ideas and there are a number of sources where a more comprehensive treatment is given. They are mentioned here primarily for the purpose of emphasis and the possibility that they might suggest new applications.

First, the house must be functional. It must work. Not only must it be soundly and durably constructed to provide necessary protection and comfort, but it must serve efficiently the purpose for which it was intended. This requires that the plan be logically organized, that it provide a functional relation between rooms arranged to suit present-day modes of living, and that it facilitate efficient housekeeping.

The plan of the house dictates primarily the exterior treatment, for the elevation is simply the external expression of internal function. Attempts to make the plan fit some preconceived idea of exterior design are likely to fail.

Second, the house must also be economical. Unnecessary features must be eliminated, space must be arranged for maximum utility, even multipurpose rooms used where possible. Maintenance and operating costs must be kept to a minimum. Construction must be simple and materials used efficiently and honestly, relying on their texture and color, together with skillful arrangement of masses and openings to produce a pleasing architectural effect.

Third, the house must meet the conditions of its environment. Climatic influences must be recognized and expressed in the design. The site must be considered with regard to topography, orientation, and surrounding buildings. Native materials should be used to an advantage wherever possible, contributing not only to a more economical building but to one more in keeping with the locality.

Just as basic as the functional requirements are the esthetic qualities which the house must possess. No dwelling can make a satisfactory home if it provides merely for the mechanics of living. In any house, no matter how small, there must be a sense of comfort in its character and detail, a feeling of charm in its appearance and setting. Standards of design must therefore be equally considered along with standards of construction. While it may be necessary to reduce this basic house to the simplest of shapes, even to a box, it must nevertheless be a well-proportioned box with its mass and materials and openings treated with skill and imagination, and even at some slight increase in cost, elements whose primary justification is their decorative quality must be regarded as essential to the pleasure which the owner will take in his home.

There can be no quarrel with these principles, nor can there be any question regarding the possibility of applying them to farmhouses. Yet to even the casual observer, it must be apparent how seldom these principles have been satisfactorily applied. It is not difficult to understand why this is so when one considers the lack of qualified designers. Because farmhouses are usually built at low cost, they have not been profitable to professional architects, nor have they as a rule attracted even the more highly skilled builders and contractors. Since adequate plan services offered by various state colleges and the U. S. Department of Agriculture have been available for only a few years, it is obvious that for many years in which economic and technical changes have created new problems in housing that the farmhouse has not had the attention of trained men.

Furthermore, it is plain that it will be necessary for these same public agencies to carry the burden of this responsibility since no increased activity in this field is immediately anticipated from private enterprise. It will be necessary for the research, extension, and other interested agencies of our federal and state governments to cooperate and to coordinate their efforts in this work.

Although many of the problems call for trained technical service, it is highly important to raise the rural family's conception of adequate housing to convincing them of the advantages of new and better (Continued on page 349)

Paper presented before the Farm Structures Division at the annual meeting of the American Society of Agricultural Engineers at Knoxville, Tenn., June 1941. Author: Formerly architectural designer, Bureau of Agricultural Chemistry and Engineering, U. S. Department of Agriculture, now in private architectural practice.

Engineering Aspects of Electric Brooding in Winter

By John E. Nicholas, E. W. Callenbach, and R. R. Murphy
MEMBER A.S.A.E.

THE NUMBER of chicks that can be reared under the canopy of an electric brooder has been a moot question since the beginning. Nearly everyone has had a definite recommendation, perhaps with some justification. Since no experimentally determined values have been available, the generally accepted figure has been 7 sq in of warm brooder canopy area per chick. In the past, this has been used as the unpredetermined but accepted standard, and, therefore, it formed the basic area in these experiments.

This paper reviews certain engineering information secured in two experiments which will be reported in detail at a later date. The experiments involved a study of space requirements of chicks brooded under electric brooders, in cold weather. In each experiment, 1766 chicks were brooded, in paired groups, under eight electric brooders of the same size, make, and design. Brooder allowances per chick were 7, 11, 15, and 19 sq in for each pair of groups. The first experiment, with Single-Comb White Leghorn chicks, was started on February 1, 1939; the second, in which Barred Plymouth Rock chicks were used, was started on December 5, 1940. Each experiment extended over a period of eight weeks.

Equipment and management for all groups were comparable, but varied according to the requirements of each particular group. Every attempt was made to rear the maximum number of desirable birds. Brooder houses[1] were similar, but varied slightly in some respects, as shown in Fig. 1. Houses numbered 1 to 8 inclusive were used in experiment No. 1; 1 to 4 and 9 to 12 inclusive were used in experiment No. 2. The electric service, also indicated in Fig. 1, was somewhat different in the two experiments in that the load was divided between two circuits in experiment No. 2, whereas a similar load was carried on one circuit in experiment No. 1. The change was made on the first day of the second experiment when difficulty in bringing the brooders up to temperature was experienced.

Paper presented before the Rural Electric Division at the annual meeting of the American Society of Agricultural Engineers at Knoxville, Tenn., June 1941. Authorized for publication, June 19, 1941, as Paper No. 1036 in the Journal Series of the Pennsylvania Agricultural Experiment Station. Authors: Respectively, professor of agricultural engineering, professor of poultry husbandry, and assistant professor of poultry husbandry, The Pennsylvania State College.

[1]"A Practical Brooder House." The Pennsylvania State College, Division of Agricultural Extension, State College, Pa.

Voltage Variation. Electric heating is directly dependent upon uniform voltage; therefore, an adequate supply of heat from any electric brooder can be expected only if there is little or no voltage variation. Table 1 gives the connected load and voltage variation which existed in the first season's study. It will be observed that brooder house 8, at the farthest end from the transformer pole, showed the most variation in voltage. Table 2 shows the voltage variation as of December 4, 1940, prior to redistribution of the load, and subsequent readings on four separate days after the change was made. Chicks were under the brooders at the time of each reading.

In order to have a continuous graphical record of small variations in wattage, which is a function of voltage, a polyphase recording wattmeter was installed in brooder house 2 of experiment No. 2. A continuous record for one week was obtained. A portion of this record, showing the connected load in watts as of January 22, 1941, is

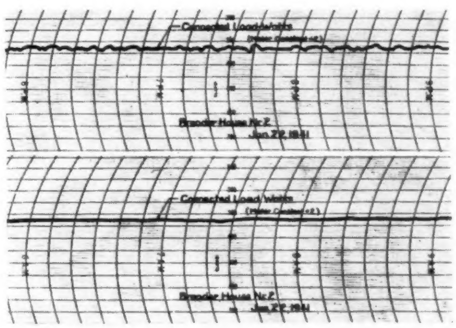
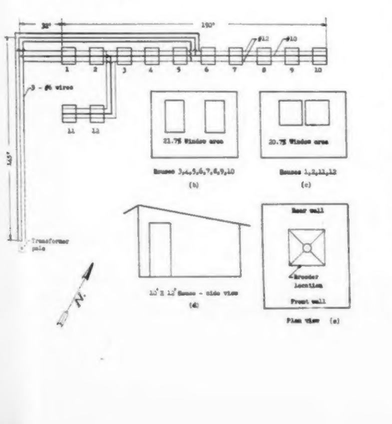


Fig. 2 The connected load in watts (meter constant = 2) as determined by a polyphase recording wattmeter in brooder house 2, as of January 22, 1941, for equal intervals of time and between same hours in the morning and evening. Experiment No. 2

shown in Fig. 2. Wattage variation was apparently greatest during the evening between the hours of 6 and 9. During the morning hours of 6 to 9, wattage was practically constant, but at a lower level.

Fig. 3 is a graphical analysis of the relation between the voltage and the connected load in watts for one of the



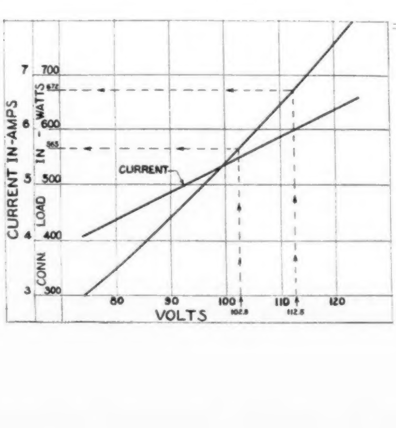
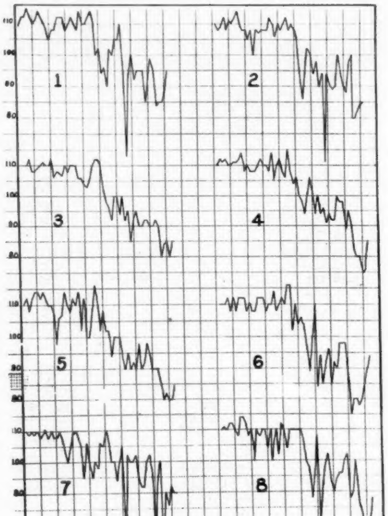


Fig. 1 (Extreme left) Dimensional arrangement (a) of colony brooder houses, location of transformer pole, and sizes of feed wires; front wall window spacing and per cent of window area, (b) and (c); side (d) and plan (e) view of houses, indicating locations of door and brooder, respectively • Fig. 3 (Left) The relation between voltage and connected load in watts for one of eight brooders operated is shown graphically here

brooders used in both experiments. As an example, it may be observed that when the voltage was 112.5, the connected load was 672 w. A decline of 10 v to 102.5 v resulted in a connected load drop of 107 to 565 w. This is equivalent to (107x3.415 Btu per watt) 365 Btu less heat. The drop in voltage may result either from an excessive length of wire or from too small a wire for the amount of connected load.

Recorded Brooder Thermometer Readings. The original thermostat setting for all brooders in both experiments was for a thermometer reading of 110 F (degrees Fahrenheit), the bulb of the thermometer being 5 in above the litter at the usual location under the canopy. Thermostat adjustments were made as needed, but short period control was maintained by elevating and lowering the canopy rather than by thermostat manipulation.



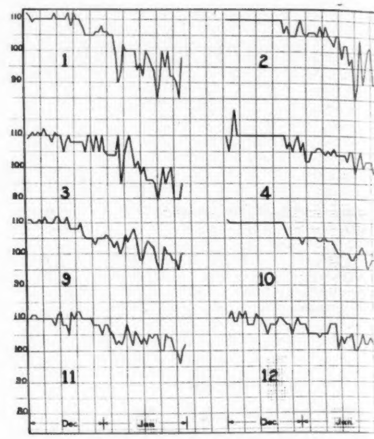


Fig. 4 (Left) Brooder temperatures under the canopies as indicated by brooder thermometer readings recorded once daily each morning between 7:00 and 8:00 a.m., for the eight brooders, 1939, experiment No. 1 • Fig. 5 (Above) The same for the eight brooders, 1940-41, experiment No. 2

TABLE 1. CONNECTED LOAD AND VOLTAGE VARIATION WITH EIGHT BROODERS OPERATING

March 3, 1939 — Experiment No. 1

Brooder house No.	Instantaneous readings, con. load in w	(A later interval) Voltage variation, 1 min interval a	b	c	d	e	No. of chicks
1	670	109	109	110	110	112	357
2	640	111	111	109	108	107	227
3	650	105	106	107	108.5	111	167
4	650	109	109	110	109	110	132
5	590*	106.5	107	105.5	106	110	357
6	580*	103.5	103	101.5	104	101	227
7	560*	103	103.5	106	106	105	167
8	560*	106	105	105	108	109	132

*These readings were taken when all eight brooders were in operation and the voltage was 100 v.

Fig. 4 shows the brooder thermostat readings for the eight brooders used in the first experiment with Single-Comb White Leghorns. Fig. 5 shows similar data for the second experiment in which Barred Plymouth Rocks were used. Two facts should be noted: First, there was a more constant temperature in experiment No. 2; second, temperatures were reduced much less in experiment No. 2 than in experiment No. 1. These conditions were due to a rising room temperature as experiment No. 1 progressed and a lowering temperature at similar times in experiment No. 2. In electric brooding, a higher brooder *thermometer* temperature is necessary for older birds under conditions of decreasing room temperature in order that proper ventilation and sufficient head room may be provided without chilling the chicks. The actual heat applied to the chicks may also be greater since more "warming" is necessary than when more moderate room temperatures are in effect.

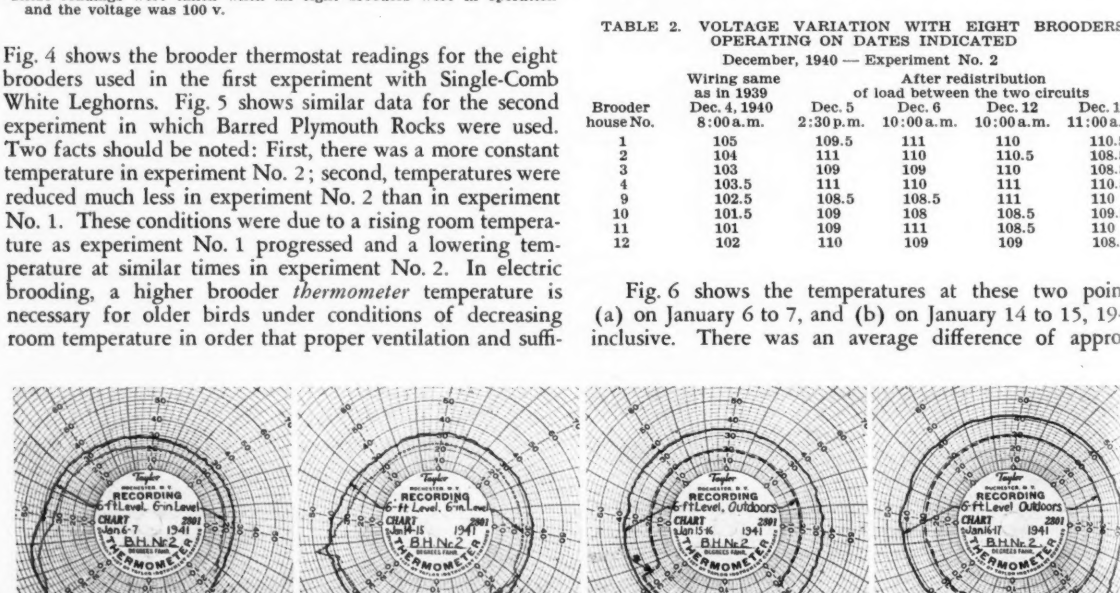
House Temperature, Humidity, Condition of Litter, and Energy Consumption. A practical brooder house, such as used in these experiments, provides shelter from snow and rain and acts as a barrier to prevailing winter winds. In order to obtain differences between inside and outside air temperatures, a bi-recording thermometer was used in brooder house 2, in experiment No. 2, to determine house temperatures at 6-in and 6-ft levels inside the house.

TABLE 2. VOLTAGE VARIATION WITH EIGHT BROODERS OPERATING ON DATES INDICATED

December, 1940 — Experiment No. 2

Brooder house No.	Wiring same as in 1939 Dec. 4, 1940 8:00 a.m.	After redistribution of load between the two circuits Dec. 5 2:30 p.m.	Dec. 6 10:00 a.m.	Dec. 12 10:00 a.m.	Dec. 19 11:00 a.m.
1	105	109.5	111	110	110.5
2	104	111	110	110.5	108.5
3	103	109	109	110	108.5
4	103.5	111	110	111	110.5
9	102.5	108.5	108.5	111	110
10	101.5	109	108	108.5	109.5
11	101	109	111	108.5	110
12	102	110	109	109	108.5

Fig. 6 shows the temperatures at these two points: (a) on January 6 to 7, and (b) on January 14 to 15, 1941, inclusive. There was an average difference of approxi-



(a) (b) (c) (d)

Fig. 6 Air temperatures in brooder house 2 (a) at 6-in and 6-ft levels on January 6 to 7, 1941; (b) at same points 8 days later; (c) when the sensitive bulb at the 6-in level was changed to the outside of the brooder house on January 16, 1941 (*indicates change to outdoors); and (d) air temperatures inside and outside, January 16 to 17, 1941, showing that the brooder house provided but a 12-deg protection, experiment No. 2

mately 6 F at the two levels. On January 16 at 3:30 p.m., the sensitive bulb located at the 6-in level was moved to the outside air as shown in (c), while (d) indicates the temperatures of the outside and inside air as of January 16 to 17, inclusive. The sensitive bulb measuring the outside air temperature was fastened at a 6-ft level 2 in away from the east brooder house wall. The average and relatively constant temperature difference between the inside and outside air as shown in (c) and (d) was approximately 12 deg, indicating that the house itself provided a limited margin of temperature difference. Fig. 6, (a) and (b), indicates that on cold winter days the brooder house temperature at floor level was as cold as 18 F.

TABLE 3. CONNECTED LOAD, VOLTAGE, AND CURRENT VARIATIONS DURING THE BROODING SEASON OF EXPERIMENT NO. 2

Brooder house No.	December 29, 1940 I (amp)	E (v)	W (w)	January 8, 1941 I (amp)	E (v)	W (w)	No. of chicks
1	6.15	111	680	6.05	109	653	132
1	6.20	112.5	695	6.05	109.5	660	132
2	5.90	109	640	5.78	107	618	357
2	6.00	111.5	665	5.84	108	630	357
3	6.10	112.5	680	5.75	106.5	610	227
3	5.90	110.5	650	5.75	106.5	608	227
4	5.90	111	660	5.75	107.5	618	357
4	5.95	110	640	5.74	108	618	357
9	5.80	108	620	5.70	106.5	608	132
9	5.90	111	650	5.68	106.5	608	132
10	5.85	110	640	5.70	108	610	167
10	5.90	111.5	650	5.70	108	610	167
11	5.80	109	625	5.76	108	615	227
11	5.90	110	640	5.74	108	615	227
12	5.70	108	630	5.60	107	620	167
12	5.80	110.5	650	5.55	106.5	612	167

Fig. 7 shows the temperature and humidity in houses 1 and 2, experiment No. 2, from January 24 to January 31, 1941. The humidity was determined by hythergraphs located at approximately 5-ft levels on brackets along the west wall. In brooder house 2, with the greater number (357) of chicks, humidity was generally at saturation. To decrease this high relative humidity and produce some drying of the walls and ceiling, an exhaust fan was placed in the top of one of the front windows. The window was lowered sufficiently to permit passage of exhaust air. Results of this installation are shown in the humidity chart for house 2, the lowest curve of Fig. 7. With the fan in operation, humidity in house 2 was reduced so that it exceeded 78 per cent on only two occasions. In house 1, with less than one-third the number of chicks in house 2, the average humidity for nearly 3 days was above 90 per cent and reached saturation on one occasion.

As indicated above, due to low air temperatures and accompanying high relative humidity, the walls of most of the brooder houses, in experiment No. 2, were always wet. As a consequence, the litter (planer shavings) also became damp very quickly. Toward the end of each experiment, frequent litter changes became necessary and were made when conditions warranted.

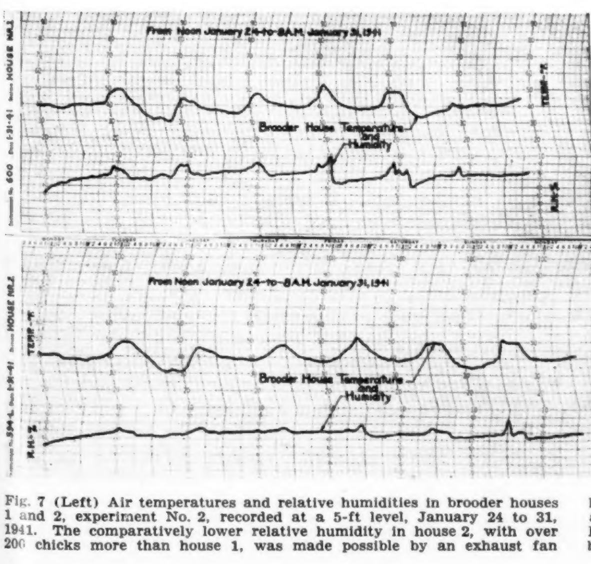
In order to compare performances of the two seasons, and resulting energy consumption, inside, outdoor, and brooder thermometer readings were plotted graphically in Fig. 8 for house 1, in which 357 chicks were brooded in 1939 and for house 2 in which the same number of chicks were brooded in 1940-41. The brooding season of December 1940 and January 1941 was far more severe than that of February and March 1939. The energy consumption curve in kilowatthours per day plots a definite rise toward the end of the 1940-41 season, whereas comparative energy consumption in kilowatthours per day dropped definitely toward the end of March, in the 1939 experiment.

The total kilowatthours per brooder and kilowatthours per chick reared are shown in Tables 4 and 5. Flock mortality, the only biological data to be reported here, is also indicated. Energy consumption per chick reared varied inversely with the number of chicks placed under each brooder. The total kilowatthours per brooder was much more variable than might be expected. It should be emphasized again that each group of chicks was managed to produce the greatest number of good 8-week-old birds. As experienced poultrymen know, groups of chicks, of apparently identical breeding and selection, often differ

TABLE 4. ENERGY CONSUMPTION AND MORTALITY OF SINGLE-COMB WHITE LEGHORNS

February 1, 1939 to March 28, 1939, 56 days. Experiment No. 1

House No.	Number of birds at start	at end	Mortality Number	Per cent	Total kwhr 56 days	Kwhr per day	Kwhr per chick reared
1	357	335	22	6.2	505	9.02	1.51
2	227	220	7	3.1	516	9.21	2.35
3	167	164	3	1.8	510	9.11	3.11
4	132	127	5	3.8	472	8.45	3.72
5	357	331	26	7.3	526	9.40	1.59
6	227	222	5	2.2	454	8.10	2.05
7	167	163	4	2.4	536	9.57	3.29
8	132	121	11	8.3	494	8.84	4.08



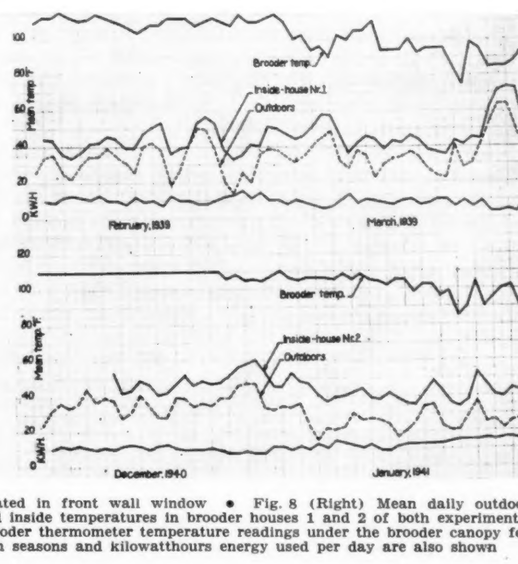


Fig. 7 (Left) Air temperatures and relative humidities in brooder houses 1 and 2, experiment No. 2, recorded at a 5-ft level, January 24 to 31, 1941. The comparatively lower relative humidity in house 2, with over 200 chicks more than house 1, was made possible by an exhaust fan located in front wall window • Fig. 8 (Right) Mean daily outdoor and inside temperatures in brooder houses 1 and 2 of both experiments. Brooder thermometer temperature readings under the brooder canopy for both seasons and kilowatthours energy used per day are also shown

much in their behavior and mechanical requirements. The energy consumption data, which show a great variation between commercially identical brooders used to brood equal numbers of chicks, indicate the need for caution in drawing conclusions from comparative tests involving one sample of chicks in competing makes of brooders. This is even more apparent when it is realized that some brooders, because of differences in design, must be manipulated differently from other types equally as satisfactory in rearing good chickens.

Table 4 indicates that the minimum energy consumed in 56 days of brooding in 1939 was 454 kwhr, while the maximum was 536 kwhr. This gives a differential of 82 kwhr during the first season. The minimum energy consumed during the second season was 655 kwhr while the maximum was 798 kwhr. The differential here is 143 kwhr, or 61 more than in the first experiment. There is no apparent consistent relationship between the number of chicks per brooder group and energy consumed or mortality in the two experiments. During the first year, brooders given the maximum number of chicks (357), houses 1 and 5, were most efficient, as measured by kilowatthours per chick reared. Energy consumption amounted to 1.51 and 1.58 kwhr per chick, respectively. The brooders in houses 2 and 4, given the same number of chicks in the second season, showed a performance of 2.12 and 2.22 kwhr per chick reared.

TABLE 5. ENERGY CONSUMPTION AND MORTALITY OF BARRED PLYMOUTH ROCKS

December 5, 1940 to January 31, 1941, 56 days. Experiment No. 2

House No.	Number of birds at start	Number of birds at end	Mortality Number	Mortality Per cent	Total kwhr 56 days	Kwhr per day	Kwhr per chick reared
1	132	130	2	1.5	777	13.9	5.98
2	357	316	41	11.5	670	12.0	2.12
3	227	220	7	3.1	655	11.7	2.98
4	357	314	43	12.0	699	12.5	2.23
9	132	124	8	6.1	713	12.7	5.75
10	167	160	7	4.2	784	14.0	4.90
11	227	216	11	4.8	798	14.2	3.70
12	167	163	4	2.4	710	12.7	4.36

These differences in energy per chick reared are, as explained previously, due mainly to the more severe brooding season of 1940-41. As might be expected, the most expensive brooders to operate were those in which the minimum number of chicks were housed, namely, 132. Table 6 shows comparative data of the two brooding seasons. On the basis of kilowatthours per chick reared, without considering chick quality or commercial value, the greatest number of birds housed gave maximum economy of operation. Since the 1940-41 season was more severe, the energy used in the two houses with the maximum number of chicks was greater by 40.4 per cent than the consumption in similar houses in 1939.

Highest mortality occurred in the 1940-41 season in houses where only 7 sq in, the smallest allowance per chick of brooder space, was provided. On the basis of mortality alone, an allowance of 15 sq in per chick of brooder area was best although only slightly and insignificantly so when compared with the allowance of 11 sq in.

Much of the chick mortality occurred during the first week. There were two primary causes: First, weak chicks and those failing to find feed and water promptly were eliminated at this time. The latter condition is always true in large groups. Second, on two different occasions in the 357-chick (7-sq-in) groups in experiment No. 2, small groups of chicks evidently got pushed out from under the brooder canopy at night, and in huddling to keep warm piled up and were suffocated. This occurred in spite of night illumination of the houses. It is important to remember that such mortality was not necessarily due to absolute lack of space under the canopy, but rather to the chicks entering the cold environment of the house and failing to return.

TABLE 6. COMPARATIVE DATA OF TWO YEARS' BROODING

Brooder houses No. Exp No. 1 1939	Brooder houses No. Exp No. 2 1940-41	Chicks at start both years	Sq In brooder area per chick	Per cent mortality 1939	Per cent mortality 1940-41	Kwhr per chick reared 1939	Kwhr per chick reared 1940-41	Total kwhr in 8 weeks 1939	Total kwhr in 8 weeks 1940-41
8	9	132	19	8.3	6.1	4.08	5.75	494	713
4	1	132	19	3.8	1.5	3.72	6.02	472	777
7	12	167	15	2.4	2.4	3.29	4.35	536	710
3	10	167	15	1.8	4.2	3.11	4.90	510	784
6	11	227	11	2.2	4.8	2.05	3.70	454	798
2	3	227	11	3.1	3.1	2.35	2.98	516	655
5	4	357	7	7.3	12.0	1.59	2.22	526	699
1	2	357	7	6.2	11.5	1.51	2.12	505	670

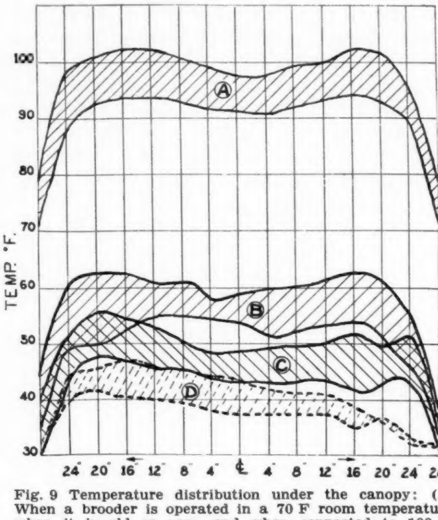


Fig. 9 Temperature distribution under the canopy: (A) When a brooder is operated in a 70 F room temperature, when it is old or new, and when connected to 100 or 112 v with no barrier around it to prevent drafts; (B) when a new brooder heating on 112 v is placed outside the building, exposed to a cold wind of 23 to 30 F temperature, and a barrier is placed around the canopy to prevent drafts; (C) when a used brooder with its insulation nearly 70 per cent gone is operated in an environment similar to (B); and (D) when (C) is repeated but the barriers are removed, permitting full draft of wind under the canopy

Apparatus Check-Up After Termination of the Experiment. At the completion of the second season of brooding all of the brooders used during the test were checked for wear and performance. The amount of damage found in the different brooders varied, but did not materially affect performance so far as heat distribution is concerned in warm environments. Fig. 9 shows the results of a temperature distribution test, without chicks, under the canopies of new and used brooders in a warm room environment between "off" and "on" heating cycle. (A) shows the temperature distribution under a brooder (old or new), when operated on 110 to 112 v or 98 to 100 v, taken in a warm environment. The low voltage apparently had no significant effect on heat distribution, but in a cold environment the brooder could not be brought to temperature (see B). Since the brooder house temperatures in experiment No. 2 reached a low level of 18 F, it was deemed advisable to determine the temperature distribution under a representative brooder in a cold environment. Temperature distribution measurements were, therefore, made under a new brooder which was placed on a piece of half-inch insulation board in the outside air when the temperature varied between 23 and 30 F. The temperatures were read by thermocouples at points 2½ in above the insulation board. (B) shows results obtained in a 6-hr test, with a

barrier around the canopy to eliminate possible drafts. A used brooder in which part of the insulating material had been destroyed by the chicks, when tested under the same conditions as that shown in (B), gave the results indicated in (C). Here the value of insulation is definitely apparent. Comparing (A) and (B), it will be noted that in a cold, exposed environment, with a prevailing wind passing over the brooder, it was impossible to obtain a temperature higher than 63 F with a new brooder, when the outside air was 30 F. With the old brooder used for (C), the maximum temperature under the same circumstances was approximately 56 F. When the draft barrier was removed and condition (C) repeated, the results shown in (D) were obtained. The maximum temperature under the brooder was about 18 F warmer than the outside air. This temperature was obtained under that side of the brooder farthest from the side from which the wind was blowing. The results shown in Fig. 9 were all secured with a line of 112 v. The brooder thermometer in all cases registered a temperature 10 deg higher than any temperature shown by the charts in (A), (B), (C), or (D). This was caused by the greater proximity of the thermometer bulb to the heating element than the thermocouple points referred to above.

Table 6 summarizes and gives comparative results of the two years' chick brooding.

SUMMARY

1 Engineering aspects of two electric brooding experiments, conducted under cold weather conditions, are discussed.

2 Three thousand five hundred and thirty-two chicks of two different breeds were brooded under 8 electric brooders of the same size, make, and design.

3 In each experiment, duplicate groups of chicks, numbering 132, 167, 227, and 357 chicks per group, were provided comparable brooding conditions except for respective allowances of 7, 11, 15, and 19 sq in per chick of brooder area.

4 Single-Comb White Leghorn chicks were used in the 1939 experiment. Barred Plymouth Rock chicks were brooded in 1940-41.

5 Housing, rearing equipment, and management were strictly comparable, but varied with the individual requirements of each group of chicks, every effort being made to grow the maximum number of good chicks to 8 weeks of age.

6 Voltage variation, particularly low voltage caused by too light service wiring, was shown to influence seriously the generation of sufficient heat under brooders in cold weather and to reduce greatly their efficiency.

7 Brooder thermometer temperature readings serve as a guide to conditions under an electric brooder, but must be used with judgment since temperature control and ventilation requirements are sometimes best effected by elevation or lowering of the brooder canopy.

8 In crowded brooder houses, the problem of extreme dampness in cold weather may be partially alleviated by the use of an exhaust fan. The economics of this procedure have not been studied.

9 Energy consumption was found to be higher in a season of decreasing environmental temperature.

10 Energy consumption per chick reared was less for the largest group of chicks.

11 No consistent relationship was found to exist between number of chicks and energy consumption per group or between number of chicks per group and brooding mortality. An allowance of 7 sq in per chick of brooder area resulted in the highest mortality.

Architectured Homes for American Farms

(Continued from page 344)

ideas, improved methods, new materials or new uses of old materials.

In connection with the farm housing research project being conducted at the University of Georgia at Athens, the opportunity has come to offer within a very limited range architectural services to farm families planning to build or remodel. These services include preliminary sketches, the preparation of working drawings and specifications, and supervision of some of the actual construction. This assistance, for which there is no charge, is extended in return for test data, research, and demonstration privileges which are afforded by the house. Working with these people in developing acceptable plans, it is surprising to find their indifference and even resistance to efforts made to provide them with a satisfactory design developed to meet their own particular requirements. They have seen poorly designed and cheaply constructed houses so often that they have become used to them and have little appreciation for anything better because it is unfamiliar.

One factor in gaining acceptance for other designs is the country builder and small contractor who, even more than the individual farmer, constructs most of the farmhouses usually without the benefit of an acceptable plan. An even more important factor is the home magazines, the real estate sections of newspapers, and the plan booklets distributed by various materials and equipment manufacturers, all of which contain a variety of house plans usually presented in a very attractive manner which tends to hide some of their undesirable features. That most of these houses are of the urban type, designed for city lots, services, and living conditions does not seem to occur to the farmer who wants to build his house just like one of them. Neither does it occur to him that they are far above the cost range of the average farmhouse and that they often require mechanical equipment beyond the limit of farm income. Often when a family intends to build, they will clip from a newspaper a plan and a photograph, frequently not of the same house, and attempt to force them into an arrangement which will satisfy the family ambition and at the same time meet the family budget. Many times their eyes are caught by some external feature or trick of construction which may have no relation to the plan and involve an added expense. The plan may even omit certain facilities necessary in farmhouse operation. Yet they are reluctant to accept a simple straightforward design because it does not offer the novelty and variety to which they have become accustomed.

Plainly there is a great need for educating farm people to a better appreciation of good design and a higher standard of housing, as well as providing them with the services which will make these higher standards available. Most farm people realize that they need better facilities, but they should have guidance as to the best way to meet these needs. They need to see good houses to appreciate them. They need to see how attractive, comfortable, and economical a farmhouse can be made with the benefit of intelligent and skillful planning. They need to recognize the value of good design and understand why it is good—to realize the opportunities for better living made possible by better houses, the opportunities for better farms, better communities and a better and more stable rural society.

How to meet these needs effectively is a challenge to all of us who are concerned with improving ways of rural living. How well these needs are met will depend in large measure upon how willingly we accept this challenge and how well we do our job.

Hydrologic Evaluation of Watershed Improvement Programs

By R. L. Stevens and E. R. Kinnear
MEMBER A.S.A.E. MEMBER A.S.A.E.

MUCH has been said and written in recent years about the effect of the occupancy and use of the land on the occurrence and magnitudes of floods. Since the inception of the watershed improvement program of the Department of Agriculture discussion of the subject has materially increased and out of this discussion has come considerable controversy and progress. The flood control survey activity of the Department has focused much of the controversy.

Many members of the engineering profession and a considerable number of laymen interested in the related problems of land use and water have for some time raised many very reasonable questions. The general nature of the most frequent questions has been, "Assuming that land use and management do exert an influence on floods, by what process is the influence developed and how can it be measured in quantitative amounts?"

It is natural that such questions should be raised when an activity has been as widely publicized as has been the watershed phase of flood control and when almost unlimited expectations have been claimed for it. It is very important to the economics of flood flow regulation to determine the limitations of the effect of land-use changes and practices on flood discharges.

One could not hope to answer all of the questions which have been raised in a short discussion such as this. However, we can attempt to throw some light on the more basic concepts involved in the generation of flood run-off from land areas and indicate the feasibility of the quantitative measurement of the effects of land use and management on such run-off by drawing on some of the experiences of the flood survey activity of the Department of Agriculture in the past three years.

It is generally agreed that the effect of land use and management on the run-off generated by storm rainfall is manifest through three phenomena:

1 By effecting a change in the ability of the soil mantle to infiltrate rainfall

2 By increasing the retention of rainfall during a storm either on the land surface or in the soil mantle or both

3 By effecting a change in shape of a flood hydrograph by delaying run-off beyond the normal time of peaking of the hydrograph.

All three of these actions are involved in the relationship between storm rainfall and storm run-off, and in the results of changes in the physical characteristics of the land surface and its cover, and the effect of such changes on the infiltration and water storage capacity of the soil mantle.

The effect of an agricultural program on floods varies between watersheds, because of the varying conditions within the respective watersheds themselves, and the measurement of this effect is influenced by three dominant conditions, namely:

1 Where the soils in a watershed under various types of land cover are limited in their capacity to infiltrate rainfall

2 Where there is adequate infiltration capacity but the soils are limited in their capacity to retain infiltrated water

3 Where a watershed has both limiting conditions in varying degrees.

In the determination of the effect of agricultural progress on flood flows, engineers in the Department have relied heavily upon the so-called infiltration theory of run-off which can be stated briefly as follows: Surface run-off is generated from storm rainfall when areas within a watershed have a capacity to infiltrate rainfall at a rate which is less than the intensity of the rainfall.

This process is simply illustrated by Fig. 1. If an area of a given soil under a given cover is subjected to the storm

Paper presented before the Soil and Water Conservation Division at the annual meeting of the American Society of Agricultural Engineers at Knoxville, Tenn., June 1941. Authors: Head, section of hydrology plans, and senior soil conservationist, respectively, project plans division, Soil Conservation Service, U. S. Department of Agriculture.

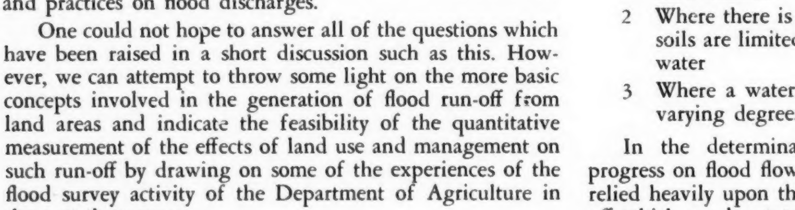


Figure I

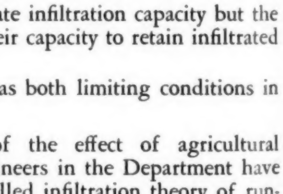
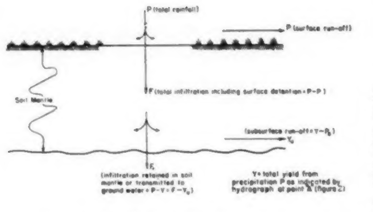


Figure 2

illustrated and the curve A is the infiltration capacity of the soil-cover complex, the more darkly shaded portion of the diagram represents the surface run-off generated by the storm occurring on the area.

In applying this theory to the evaluation of the effect of land-use modifications on flood discharges we have had to accumulate data which would assist us in determining the infiltration capacities of various soil and cover complexes within the watersheds under survey. Many are familiar with the equipment and method which have been developed by the Department for obtaining these data, but for those who may not be they will be described briefly.



IMMEDIATE DISPOSITION OF RAINFALL

Figure 3

The apparatus which we call an infiltrometer consists of a rainfall simulator of several rotating nozzles by which water is applied to a small measured plot around which a metal border has been placed at several inches depth and the top of which is slightly above the ground surface. The simulated rainfall is applied to the plot at a known rate, and the run-off from the plot is measured in a collecting device at the lower plot boundary at frequent time intervals. The difference between the rate of rainfall application and the rate of run-off is calculated and an instantaneous rate curve developed from these calculations. The resulting curve is not actual net infiltration but includes surface detention.

Data used in the determination of the infiltration capacities of various soil and cover complexes in a watershed are obtained by making a sufficient number of infiltrometer tests on each complex to insure a dependable average value. These data are supplemented by results obtained from plot and watershed measurements made at experiment stations on similar soil-cover complexes, and the resultant composite determinations are used in the selection of the final values in the process of hydrologic evaluation.

We would like to illustrate the step-by-step procedure developed for hydrologic evaluation purposes in determining the effect of an agricultural program on flood flows on a small watershed where the limiting factor is the capacity of the soil surface to infiltrate rainfall and where flood events are not complicated by snow melt. For watersheds with conditions other than these many of the individual steps are similar but the evaluation methods vary due to the conditions encountered.

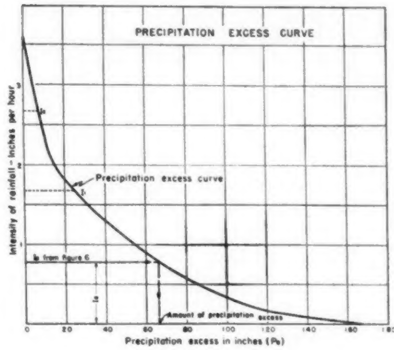


Figure 4

We will assume a watershed on which flood damage occurs along the stream valley and the damage has been related to various magnitudes of flood discharge by means of stage and acres inundated at a point for which an evaluation of reduced run-off is to be made. The point is usually at a location where discharge measurement records are available and flood magnitudes have been computed by the usual hydraulic procedures. The contributing area of the watershed is made up of a number of complexes of soil and cover conditions, and for each complex infiltration rate curves have been determined by the use of infiltrometer and other data.

Under the procedure used the surface run-off on each complex is computed, and the summation of computed run-off from the total area of all complexes is assumed to be the surface run-off appearing in a hydrograph at the point A of Fig. 2. Either a recorded storm or one of uniform average depth and distribution of intensity is then applied to the watershed and we desire to determine the effect of an agricultural program on the resulting flood run-off.

The disposal of the rainfall can be shown as indicated on Fig. 3. The precipitation P applied to the land surface results in surface runoff P_e in an amount in excess of the capacity of the land surface to infiltrate water after depression storage, interceptions, etc., have been satisfied. The rainfall other than that accounted for as precipitation excess, depression storage, interception, and evaporation, infiltrates into the soil mantle as total infiltration F. Of this quantity a certain portion of the infiltrated water is retained, F_r. If the storage capacity of the soil mantle and substrata is less than the total infiltration, an amount, Y_u, is returned to the stream as a subsurface flow and the sum of this return flow and the surface flow is the total yield, Y, appearing in the flood hydrograph. The quantity of surface and subsurface run-off generated by a storm varies with the capacity of the land surface to infiltrate and the soil mantle to retain infiltrated water which in turn are functions of the condition of the land due to antecedent rainfall or drought periods.

We wish to touch upon the procedure for determining the surface run-off item in the illustration.

Since the flood producing rainfall is known the first step in the determination is the derivation of two curves from the precipitation record. These have been designated as the Precipita-

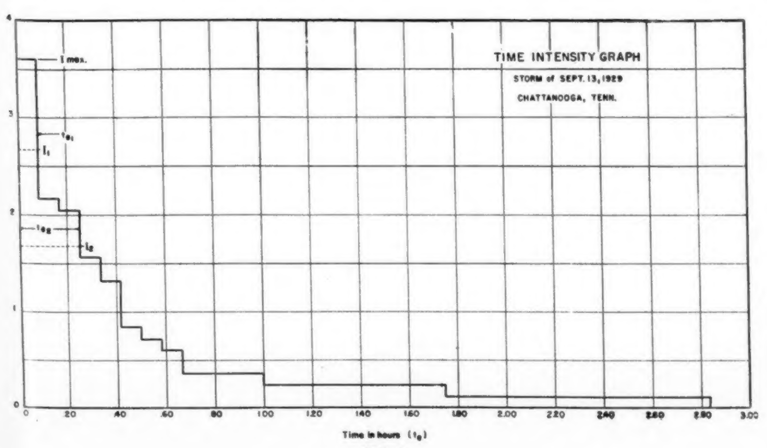


Figure 5

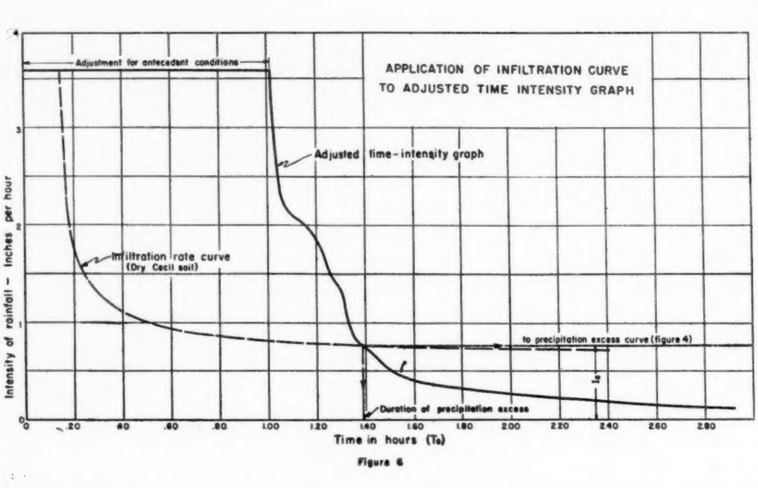


Figure 6

tion Excess Curve (Fig. 4) and the Time Intensity Graph (Fig. 5).

The precipitation excess curve is developed by what, in effect, is a rearrangement of the histogram of rainfall in the descending order of intensities recorded, plotting as abscissa the total amount in excess of a series of intensities. By this rearrangement the volume of precipitation in surface inches that fell during the storm at an intensity over and above I_1 is equal to the area under the curve above I_1, and the total volume recorded above I_2 is equal to the area under the curve above I_2, etc.

From this relationship the second relationship of time and intensity, the duration of excess precipitation, is derived. This may also be shown as a curve through the midpoint of the abscissa increase (in this case) or through the outer point of the steps, depending upon the basis of the derivation of the points. A plotting is made of the time during which rain fell at an intensity over and above I_1, I_2, etc. This time is illustrated as t_{e1}, t_{e2}, etc. T_e is duration of precipitation excess.

Since an infiltration capacity for a soil-cover complex is also a rate-time curve similar to the time of excess curve, and if plotted to a scale identical to the T_e curve, it can be superimposed over the T_e curve as shown in Fig. 6. The intersection of the two curves results in the limiting rate of infiltration, I_a in inches per hour, for the complex during the applied storm. If we enter the precipitation excess curve with this rate as an ordinate and intersect the P_e curve, the abscissa of the intersection will be the unit volume of precipitation excess or surface runoff, P_e, generated on the particular complex to which the infiltration curve applies as shown in Fig. 4.

The precipitation excess amounts for each complex are determined in the same manner by applying the appropriate infiltration curves to the T_e curve. The resultant rates from the P_e curve, when multiplied by the areas in the various complexes in the watershed and summated, yield a computed value for the surface run-off in inches from the watershed.

The same procedure is used in computing the modified surface run-off which will result following the installation of watershed treatment measures. Additional infiltration curves are determined and used for the changed complexes, and the same infiltration curves are used for the areas which will remain unchanged.

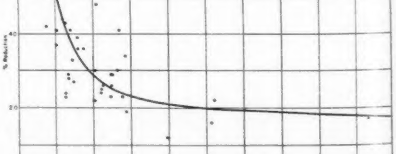
The accuracy of these derived estimates is dependent, to a great extent, upon the accuracy of the infiltration curves developed, and on the proper selection of the intersection of the curves when applied to the rainfall time of excess curves. Experiment station data on small plots and watersheds have been invaluable in assisting in a rational determination of these basic factors for watersheds on which proposed agricultural watershed programs have been evaluated.

We have relied upon the results of analysis of experiment station data to a considerable extent in arriving at estimates of the effect of antecedent rainfall on the depletion of infiltration capacity and storage capacity of the soil mantle and in the determination of the effect of various land covers on infiltration capacities during different seasons of the year. The comparison of computed surface run-off from known storms by the above method to actual volumes of run-off from the same storms measured at stream gaging stations, is being used to relate calculated results into a proper datum.

Procedures have been developed by technicians in the survey activity of the Department whereby reasonable estimates can be made of subsurface return flow from watersheds during flood periods. Time is not adequate for presentation of all of the recent developments of methodology and results of the studies which are necessary in the hydrologic evaluation of the watershed improvement programs which have been recommended by the Department on the various watersheds surveyed under the Flood Control Act.

In the past year or so, technicians in the Department have made progress in this field by hydrologic evaluation which until recently appeared to present insurmountable problems. We are now able to show by defensible methods that the effect of improved land use and practices on reducing flood flows is significant. This effect varies, of course, for different areas and watersheds, due to physical characteristics, climate, and economic limitations of land operators. Some of the typical variables encountered are geographic location, magnitude of floods, and the seasonal occurrence of floods. We believe that the estimates made of the effect of proposed programs on flood flow reduction are reasonable, and it is hoped that we can continue to refine future estimates to make available increasingly defensible techniques and procedures for measuring flood flows from various soil cover conditions to those interested in and dealing with related problems of land and water.

Figs. 7 and 8 present the *(Continued on page 354)*



Machinery for Harvesting Bluegrass Seed

By J. B. Kelley

MEMBER A.S.A.E.

AS THE bluegrass region of Kentucky is known the world over for its wonderful bluegrass pastures and thoroughbred horses raised on those pastures, it is natural that Kentucky should be a leading state in the production of bluegrass seed.

The methods of stripping, handling, and curing bluegrass seed are important, as they affect the quality of the seed produced. The seed may be stripped by hand or harvested by horse or tractor-drawn machines.

The Hand Stripper. The fact that the seed of Kentucky bluegrass is in a fairly compact cluster at the top of the slender stalk permits harvesting of the seed by the comb stripper. The hand stripper consists of a triangular-shaped trough or box provided with a set of teeth known as the comb, the trough being on a short handle shaped like the upper part of a garden spade. This stripper, held in the operator's hand, when swung back and forth against the ripened heads, removes the seed and short lengths of the stems and retains them in the trough. When the trough is full, the strippings are emptied into a sack carried by the operator. The teeth of the comb of the stripper may be made of wood or metal, the commercial ones usually being formed of flat sheets of steel. With this type of stripper a good workman may harvest seed from about $1/2$ acre per day.

Paper presented before the Power and Machinery Division at the annual meeting of the American Society of Agricultural Engineers, at Knoxville, Tenn., June 1941. Author: Professor of agricultural engineering, University of Kentucky.

At present hand strippers are used only by persons who wish to earn a little money or who want only a few bushels of seed for their own use.

The Horse-Drawn Comb Stripper. Two makes of this type of stripper were developed in Kentucky. The earliest one is known as the Stivers and the other as the McCormick.

Both of these machines are enlarged comb strippers 5 ft long mounted between two wheels provided with a shaft within which to hitch a horse or mule to pull the comb through the field of grass. Two men are required to operate the machine. One man drives the animal while the other, on his knees in the bottom of the stripper, cuts and rakes the strippings back into the box away from the teeth of the comb. The two men take turns in doing the strenuous work of operating a short cutting knife. The knife is made of a flat piece of steel approximately $1/16x3\frac{1}{2}x11$ in, provided with a combination metal rod and wood handle. The edges of the steel are sharpened. When the bed of the stripper is filled, the strippings are placed in 6-bu bags and left on the ground to be picked up later.

The Revolving Comb Stripper. The McCormick revolving comb stripper (Fig. 1) provides a set of three revolving steel combs for stripping the grass. Across the upper surface of the teeth a flat steel knife actuated by gears and a rolling cam removes the strippings from the comb and causes them to fall into the hopper, from which they are carried by a slat bar elevator up to the sacks fastened to the upper edge of the incline. This machine

Fig. 1 The McCormick revolving comb stripper for harvesting Kentucky bluegrass seed • Fig. 2 Revolving beater type of harvester for bluegrass seed • Fig. 3 A large outdoor bluegrass seed-curing yard • Fig. 4 A side-delivery rake used for turning and windrowing rough seed

strips a width of 4½ ft, and when drawn by horses will harvest an area of 6 to 7 acres per 10-hr day.

The All-Steel Revolving Comb Stripper. In the McCormick all-steel revolving comb self-raking harvester the strippings are elevated into a hopper from which they are removed later by hand and placed in sacks. One of these machines drawn by a tractor will harvest 15 to 18 acres per day.

The Bluegrass Seed Header. During the 1940 season two grass seed headers designed by J. D. Gay, Jr., were used in harvesting bluegrass in Kentucky. This harvester is provided with a reciprocating knife and cutter bar as on a small grain combine. The knife cuts the heads from the stalks, and as the grass is cut, the revolving reel causes the heads to fall back onto the platform provided with an endless slatted rubber belt which conveys the clippings to the elevator — a rough-surfaced, steel-slatted rubber belt 24 in in width. At the top of the elevator is attached a hopper provided with two outlets controlled by a swinging valve so that one filled sack may be removed and replaced while a sack under the opposite outlet is being filled.

One man riding on a platform at the rear of the machine operates the bagger, the tilting lever, and the hydraulic lift which adjusts the height of the cutter bar in the grass.

AS DEVELOPMENT OF SEED HARVESTING MACHINES PROGRESSES, THEIR EFFICIENCY INCREASES

Two of these machines were operated last year. One was provided with a cutter bar 10 ft long and the other with one 14 ft long. The machines were pulled by a tractor equipped with a power take-off to operate the knife, reel, and conveyor belts of the harvester. The small, 10-ft machine was operated at an average speed of 5¼ mph and the larger one at 4¾ mph. The smaller machine harvested on an average 800 bu of rough seed per 12-hr day during 1940, or 45 acres per day.

The following advantages are claimed for this machine: (1) Less seed is lost in the field; (2) the machine does not have to be stopped to change sacks; (3) the seed cures more readily in the curing ricks, with less labor required for turning to prevent the danger of heating; and (4) better germination of seed.

The above claims were verified, but it was very difficult to separate the seed from the stems and chaff with the present types of cleaning equipment, and for this reason the designer has discarded the cutter bar and slat reel and substituted a revolving cylinder or beater.

The Revolving Beater Harvester. In the revolving beater type of harvester (Fig. 2), the cylinder is 10 ft in length and 17½ in overall diameter and is made of pressed steel disks to which are fastened wooden bars to make a solid drum into which are driven 20-penny spikes for beater teeth. The teeth are 2½ in long. These are placed spirally around the drum in sufficient number that, as the drum revolves in the grass, the seed will be beaten from the stems and thrown back on the conveyor platform.

The designer has built two machines, one 10 ft in length and the other 14 ft in length. On one machine he is using an auger conveyor on the platform, and on the other a drag conveyor made of two sprocket chains with angle iron slats placed at intervals on the chains. Both machines used this same type of conveyor for the elevators. Power for operating the machines is furnished through a power take-off from a tractor. The green seed harvested by this machine leaves less straw to be handled.

The Small Grain Combine Harvester. The small grain combine harvester has been used for harvesting grass seed in adjoining states, but not, to my knowledge, in Kentucky.

Curing Equipment. The rough seed when removed from the harvester is placed in burlap sacks which hold from 6 to 8 bu (14 lb per bu) of seed as stripped. The seed is then hauled to a suitable place for curing, located either out-of-doors or in tobacco barn, or on the floor of a tobacco warehouse.

On the curing yard or curing floor, the green seed mixed with pieces of stalk is placed in long windrows or ricks about 12 to 18 in high, 18 in wide, and spaced about 18 in apart to provide walkways.

The windrows must be turned frequently, sometimes day and night, to prevent the green seed from overheating. Overheating is the most common cause of low germination. Green seed left in sacks for three hours has been known to reach a temperature of 120 to 140 F. With proper management and favorable weather the seed may be properly cured ready for the grader and cleaner in two to four weeks.

Fig. 3 shows a large outdoor seed-curing yard near Paris, Kentucky. At the time this picture was taken over 75,000 bu of rough seed was in the ricks on the ground. Note that the site chosen for the curing yard was a pasture providing surface drainage in all directions. In preparing this area for a curing yard, the owner first cut the grass with a tractor mower and after removing the cuttings, recut the grass with a motor-driven lawn mower and rolled the ground where necessary to provide a rather smooth compact surface.

Fig. 4 shows a side-delivery rake pulled by a tractor turning and windrowing the rough seed to permit the air to circulate through it and prevent overheating. This outfit took the place of 100 men that would have been required to stir the rough seed with pitch forks. The average cost of curing is 6½ to 7 cents per bushel.

Cleaning and Grading. In Kentucky there are six recleaning and grading establishments. In the cleaning and grading process the cured seed is taken to the recleaning plants in 8-bu bags and dumped into a long conveyor box from which it is conveyed to a series of threshing and separating cylinders. Next the seed passes through a series of cleaners, then to the final gravity graders. The chaff and straw is drawn off and conveyed by air to the boilers where it is burned.

The seed is sold wholesale in 112 and 140-lb bags. Until recently the seed was sold on grades based on weight of the seed, but now the practice is being established to sell the seed based on purity and germination, regardless of weight.

Hydrologic Evaluation of Watershed Improvement Programs

(Continued from page 352)

estimates that have been made of the effect of proposed land-use programs on the Trinity and Washita River watersheds in Texas and Oklahoma. These illustrations indicate the relative effect of such programs on floods of different magnitudes. The curve for the Trinity River was prepared from estimates made by Mr. W. W. Horner of St. Louis who studied the conclusions of the Department as a consultant on hydrology. The curve for the Washita River was taken from the report of the analysis made by the Department's technicians.

Conservation in a County's "Comeback"

By F. N. Farrington

THE LAND drained by Sandy Creek in Tallapoosa County, Alabama, was, a dozen years ago, showing signs of becoming "worn out". Yet for many former years farms along that meandering stream had boasted some of the finest soil in the state. Old Sandy's watershed, it seemed, was depositing the district's top soil in its watery bosom at an alarming rate, especially when one considers the long years it takes Mother Nature to produce an inch of top soil.

At one time a leader in the production of cotton, beef and dairy cattle, swine and poultry, Tallapoosa County's yield had declined greatly by 1930. The county's cotton yield, for instance, which had been 190 lb to the acre at the turn of the century, was down to 148 lb, despite heavier and heavier applications of fertilizer and intensive boll weevil control measures. Indeed Tallapoosa County had become one of the lowest cotton producers in the Piedmont area, according to tilled acreage. Confronted by this situation, producers fully realized the need for taking immediate, drastic steps to halt erosion and a soil conservation association was formed with the backing of the county farm bureau. This organization was firmly convinced that two great conservation steps — winter legume planting and proper terracing — would work wonders and restore the county to production prominence.

Thus, in 1932, Tallapoosa County launched a conservation program which was joined, in 1934, by the U. S. Soil Conservation Service. The far-reaching results have more than justified the planning and faith shown. Cotton production leaped from its low mark of 148 lb to the acre to 177 lb in 1935, and by 1938 had soared to a new all-time high of 204 lb. This in the face of what was generally regarded as a bad crop year!

The "comeback" of eroded lands is reflected, further, by a dramatic rise all along the line — beef and dairy cattle, swine, poultry, oats, and hay — and the better living standards that have come correspondingly to once hard-pressed communities.

A study of the county's production curves reveals the interesting story of conservation in its entirety. Take cotton growing, for instance. The reduction from 190 lb per acre in 1910 to 130 lb in 1920 might be thought the fault of boll weevil infestation. No doubt the rise from 130 lb to the 158 lb per acre reported in 1925 may be traced to increased knowledge in controlling the boll weevil menace and improved methods of fertilization. But there was another drop to 148 lb by 1930, which drove home the fact that additional steps had to be taken. Very little was known about fertilizer and its proper application in 1900. Evidently the county had fertile soil and crop conditions were good, to produce 190 lb of cotton to the acre. Thus, despite more modern ideas, farmers had let the soil lose its natural fertility. It was their conclusion that the decline was the direct result of soil erosion. Proper terracing and legume planting, the result of organized agriculture, paid big dividends. By 1935 the yield was 177 lb and the peak hit the 204 lb mark in 1938 before levelling off.

At least 80 per cent of cotton acreage planted in Tallapoosa County during the last four years was planted on land that had had a good crop of winter legumes turned under, and at least 80 per cent of the crop was planted on land that is properly terraced. It is believed that these two conservation practices are directly responsible for increased production. Of course there has been some improvement in fertilizing and seed varieties, both affecting production, but the conservation practices must be given credit for the radical changes, with other improvements also playing their part.

Oat production has improved to over 30 bu per acre during recent years, and the acreage planted to hay crops has increased by leaps and bounds.

Swine production, which was at its best in 1900 with 15,351 hogs, bounded from an extremely low figure in 1930 to 11,795 in 1939. The curve is interesting. Production declined from a high of 15,351 in 1900 to 11,190 in 1910, went up to 14,487 in 1920 (under the war market stimulus), then hit the skids, sinking to a low of 5,075 in 1925. In 1930 there was very little change, but production swung into a lively upward pace once the conservation program began to get under way.

Production of beef cattle is now at its peak. The highest number of beef cattle in Tallapoosa County, except in 1938, was noted in 1910 when it had 9,046. The lowest production was in 1930 with 5,342. By 1935 this figure

This article prepared especially for AGRICULTURAL ENGINEERING. Author: County agricultural agent, Tallapoosa County, Alabama.

(Left) This view shows a field in Tallapoosa County, Alabama, that had been abandoned as worthless for fifteen years • (Right) This same field was terraced in 1933 in connection with the county soil conservation program and later planted to Austrian peas. These were plowed under in April 1935 and the field planted to cotton, which made at the rate of a bale an acre that year

Two views of Sandy Creek, Tallapoosa County, Alabama • (Left) This shows a sediment bar in 1934 which was 50 ft deep, 300 ft wide, and 1200 ft long — deposited in two years from the top soil of the county • (Right) The same location in 1941 after the Sandy Creek watershed had been properly terraced, perennial legumes planted, and a carefully planned land-use program developed. It will be noted that the sediment bar has almost disappeared, indicating that the farms of Tallapoosa County are now much better protected

had been increased to 7,020 — to 9,469 in 1938 and to 9,859 in 1939.

The lowest number of dairy cattle was recorded in 1930 with 4,953, reflecting a feed shortage for cattle. Production had been 5,000 in 1900 with a slight increase to a peak of 7,273 in 1910, followed by a gradual drop. Then the number of dairy cattle began an upward climb — 6,262 by 1935, 8,686 by 1938, 10,660 in 1939.

Poultry production from 1900 to 1932 changed but little. In 1900 there were 80,144, and by 1920 the number was 91,334. There was then a gradual slump to a low point of 73,742 in 1930. By 1935 the number had jumped back to 83,023, and from that time on a rapid increase was noted. Production was up to 134,389 in 1938 and to 177,612 the following year.

In general, the production of livestock and increase in number of livestock has followed the same curve as crop production. All of this goes back to the fact that in order to produce livestock you have to produce feed, and without proper terracing and conservation of the soil all of this would be impossible.

Information in the surveys, through 1935, was taken from federal government statistics, and the information after 1935 was secured from some 325 farmers and AAA information from Auburn. A true cross section was sought by including farm owners and tenants, white and colored, considering this to be about one-tenth of the crop land.

Tallapoosa County now has between 80,000 and 85,000 acres of crop land terraced with power equipment. Of this, the federal soil conservation service terraced approximately 27,000 acres, the remainder being the work of the Tallapoosa County Soil Conservation Association and a number of individuals who owned and operated tractor terracing equipment.

During the 1940-41 season the county association's equipment included six diesel tractors and nine terracers. Right now, at least four farmers are doing their own terracing and some custom work in their community. Practically all terracing work has been done with track-type tractors and that done with horse-drawn equipment and wheel-type tractors is not included in the figures, which are confined to terracing with heavy equipment. Machine farming has increased rapidly, chiefly because broad-base terraces were built and put into the proper condition.

These activities have been the basic foundation for a coordinated general program in Tallapoosa County. The county is in position to place a condensed milk manufacturing plant within its boundaries. It has already completed one cold storage plant and two more are under way. Cotton (excepting for 1941 when the cotton crop suffered severe damage from boll weevil infestation), livestock, hay and feed, and poultry production are improving rapidly.

Truly, an encouraging soil conservation history has been written by Tallapoosa County!

Two views of Caterpillar diesel tractors and terracing equipment owned and operated by the Tallapoosa County (Alabama) Soil Conservation Association. During the 1940-41 season, the Association's "Caterpillar" equipment included six diesel tractors and nine terracers

Electric Light for Egg Production

By June Roberts and J. S. Carver
Member A.S.A.E.

THE FIRST artificial lighting of poultry houses dates back to the backyard experiments of Dr. E. C. Waldorf in 1889 at Buffalo, New York. Although artificial light has been used for many years, only in the past 20 to 25 years has it received extended adaptations as a proven poultry practice.

Summarizing the work conducted at the various experiment stations, it was found that it had been carried on in many states of the Union. From the reports it was found that the type of work varied considerably, and the results of several of the investigations are somewhat contradictory, due possibly to lack of uniformity in housing conditions; but it was generally concluded that artificial lights, if properly handled, will increase the egg production during the fall and winter months, resulting in greater profits to the poultryman.

It was suggested by the earlier workers that the increased egg production secured by artificial lighting was due to lengthening the short days in the fall and winter, thus permitting the hens to secure a greater intake of food and water, which resulted in an increased egg production. In the past few years, however, research has indicated that different forms of light have a stimulating effect upon the reproductive organs of the hen. It would appear that certain rays and intensities of light may stimulate the anterior lobe of the pituitary gland to secrete a hormone that provides a stimulus for the development of the ova or yolks.

Many statements have been made with regard to the effect of various types and kinds of electric light on the stimulating effect for egg production. However, as yet there seems to be no definite proof that certain practices and kinds of light should be used. It is a well-established fact that electric lighting increases production.

The Washington C.R.E.A. and the division of poultry husbandry of the Washington Experiment Station set up a project in 1937 to determine the fundamental electric lighting requirements for laying hens. This project, under carefully controlled conditions, has been in continuous operation since that time.

Equipment Used. The equipment for the project included four separate rooms, each of which was insulated against both heat and light. The rooms were approximately 8 ft wide, 7 ft high, and 23 ft long. The outside walls, which consisted of 2x4-in studding boarded on both sides, were covered on the inside with a ½-in thickness of firtex and one layer of tar paper. For later tests the tar paper was covered with wrapping paper and aluminum paint. The only light to which the birds were exposed was furnished by artificial sources, the lamps being placed on the ceiling or on the side walls, or both, depending upon the study being made. All lights were controlled by electric time clocks.

Each room was similarly ventilated by forcing air from the blower house into it. The blower was of the multivane type being powered by an electric motor. By placing the blower house on the north side of the laying house, it was possible to eliminate the effects of the winter winds and to draw air from the cool, shaded side of the building during the summer. The minimum rate of air change was around two volumes of air per hour. This gave each bird 60 cu ft of fresh air per hour. As the temperatures increased, the rate of air change was increased until each bird was receiving 150 cu ft of air per hour. The air was admitted through a duct at the back of each pen. The design of the ventilating system was such as to prevent direct drafts on the birds. This duct had three 3-in openings on the upper side from which the air passed toward the ceiling. The air was removed from the room at the front through a ventilator duct that extended to within approximately 12 in of the floor. Air entering the room passed forward along the ceiling and settled down to the floor without any perceptible draft in any part of the room. The general arrangement of the pens and the equipment is shown by Fig. 1.

To eliminate the differences of temperature in the various pens due to heat given off by the lamps and to prevent cold air from being driven into the pens, a 1500-w heating unit was placed at the air inlet in each pen. These heating units were thermostatically controlled and were set to give a minimum temperature of 50 F (degrees Fahrenheit). During the warm months the air was drawn through an evaporative cooler to prevent excessive temperatures in the laying pens.

Temperature records from January 4 to January 11, 1941 show that the mean temperature for Lot 1 was 51.9 F, for Lot 2, 52.7 F, for Lot 3, 52.1 F and for Lot 4, 51.7 F. This shows that the average temperature was very nearly the same. The maximum and minimum temperatures were controlled within a 10 F range.

Each room was provided with a single-elevation, battery-type laying cage having twenty compartments. The feed troughs were located just outside the cage doors, and a water trough was placed just beyond the feed trough. A stream of water was maintained in each trough continuously so that the birds always had available a fresh supply of water. The tops and fronts of the cages were covered with a coarse mesh wire to permit the maximum amount of

Paper presented before the Rural Electric Division at the annual meeting of the American Society of Agricultural Engineers at Knoxville, Tenn., June 1941. Authors: Respectively, investigator, Washington Committee on the Relation of Electricity to Agriculture, and poultry husbandman, Washington Agricultural Experiment Station.

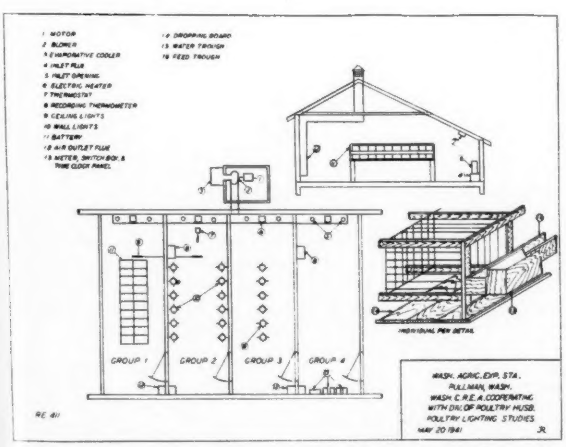


Fig. 1 General arrangement of the pens and equipment in the Washington project to determine the fundamental electric lighting requirements for laying hens

light to reach the birds and the feed troughs. Each battery had two rows, so that each row faced the outside wall.

Procedure. In the early fall months, some two hundred pullets of similar breeding were taken from the range and placed in a standard battery-type laying cage in a room adjacent to the experimental pens. They were fed laying mash and given sufficient artificial illumination to make a 13-hr day. These pullets were kept under careful observation for from 30 to 60 days, at which time 80 birds were selected from the flock, on the basis of uniform body weight and similar production records during the preliminary tests. Twenty birds were placed in each pen, and the experiment started without intervening time or tapering into the new schedule.

Records were kept on the birds during the entire test, the test being run long enough to give definite information. The daily egg production of each bird was recorded during the test. At the beginning of each week, the feed was carefully weighed. At the end of the week, the feed troughs were cleaned and the feed recovered and weighed to give accurate feed consumption records for the week.

A complete battery laying mash was fed to all lots. The formula of this all-inclusive or complete battery laying mash was:

Ingredients	Lb per ton
Millrun	582
Ground wheat	218
Ground yellow corn	146
Ground barley	72
Ground heavy oats	110
Meatscrap (55% protein)	36
Fishmeal (70% protein)	128
Dehydrated alfalfa (15 mg carotene per 100 gr)	130
Limestone grit (No. 2)	70
Granite grit (No. 2)	34
Ground oyster shell	40
Bone meal	36
Salt	20
Whole white wheat	378
Cod-liver oil	10

The body weights of the birds were recorded each 4-week period.

The production records were calculated on the percentage basis. This calculation shows the relationship between the eggs laid and the number of birds in the pen. Sickness was not considered as a reason for eliminating a bird. No bird was culled from her group for any reason whatsoever nor removed from her cage until she died. She was counted in the average until dead. Naturally the percentages in some cases were somewhat lower than they would be had the birds been culled as soon as it was noted that they were sick or that they would probably be out of production for the rest of the test. Mortality among the birds was not necessarily high as compared to the mortality of other flocks of young laying birds. Post mortem examinations were made of all birds that died during the experiment, and in no case could any definite relationship be found linking the cause of the death with the lighting conditions.

The electrical energy consumption for the lights and heat in each pen was measured by an individual watt-hour meter. These meters were read daily to check on the operation of the lights and heaters. The air movement was checked once each week by an Alnor velometer. Temperature records were taken by means of a recording thermometer throughout the test periods. The light intensity was measured once each week. Readings were taken at the feed trough and at the backs of the birds. It was found in order to maintain the same intensity that it was necessary to clean the electric bulbs once each week. During the first test, records were kept on the egg weights, yolk color, albumen index, and shell thickness. It was found that there was no significant difference in the egg study during the first test; therefore egg quality records were not determined during subsequent testing.

Definition of Terms. Per cent production is calculated on a hen-day basis. For a group to have 100 per cent production, each hen must lay an average of one egg each day. The per cent production was calculated on a two-week basis.

Per cent total production was calculated on a hen-day basis for the summation of each two-week period. The per cent production and the per cent total production would be the same for the first period. However, for any subsequent periods, they would not necessarily be the same. The per cent total production is based on the total per cent of hen-days for the total period ending on the date in question. Thus the last value of the per cent total production is the average production for each group for the entire period.

TABLE 1. EFFECT OF HOURS OF LIGHT PER DAY ON EGG PRODUCTION (NOV. 12, 1937, TO MAY 28, 1938)

Pen No.	1	2	3	4
Kind of light	Mazda	Mazda	Mazda	Mazda
Light intensity at feed trough, ft-c	7.5	7.5	7.5	7.5
Hours of light per day	3[a]	10	17	24
Avg feed consumption per bird for each 28-day period, lb	6.3	6.1	7.3	6.5
Avg gain or loss in body weight for 28-week period, lb	+0.14	+0.21	+0.07	—0.07
Mortality[b] (number of birds)	6	5	6	4
Egg weight, grams	56.8	57.5	54.7	55.4
Yolk color[d]	14.6	14.5	14.1	14.4
Albumen index[c]	107.5	102.9	99.9	99.7
Shell thickness, in	0.0316	0.0332	0.0303	0.0314

[a]1 hr in morning, 1 hr at noon, and 1 hr in evening.

[b]Post mortem examination showed death was caused by leucosis in all cases.

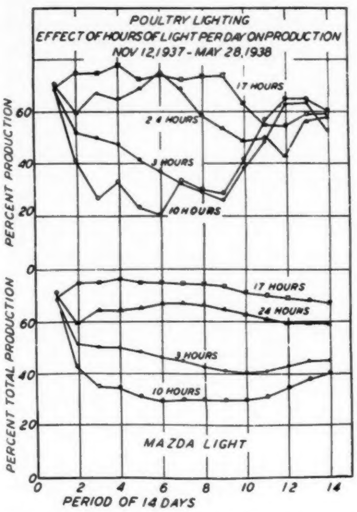
[c]Heiman and Carver. The Albumen Index as a Physical Measurement of Observed Egg Quality. Poultry Science 15:141-8. March 1936.

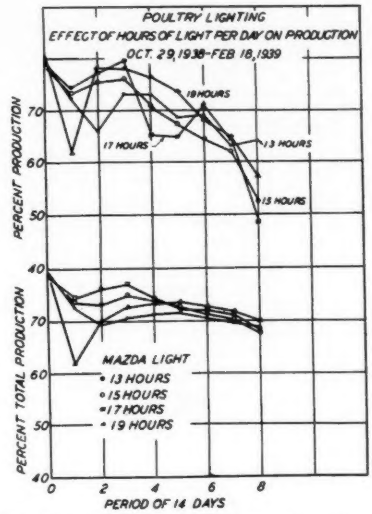
[d]The Yolk Color Index. U. S. Egg and Poultry Magazine 41:40-41. August 1935.

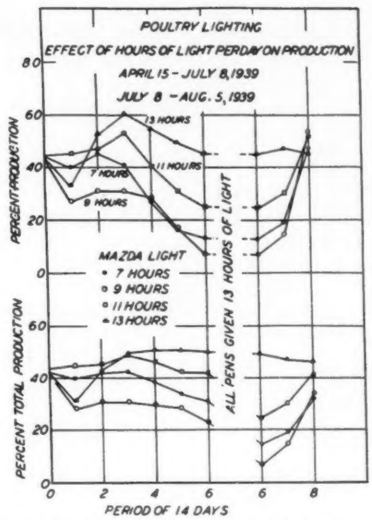
Results, Part I. Table 1 shows the effect of hours of light per day on egg production from November 12, 1937, to May 28, 1938. In this test, six 60-w Mazda lamps were spaced at 2-ft intervals over the tops of the laying pens. The hours of light per day for Pen 1 were three hours—6:00 to 7:00 a.m., 12:00 to 1:00 p.m., and 5:00 to 6:00 p.m. For the other pens the lights were turned on at 6:00 a.m., and off to give them, respectively, 10, 17, and 24 hr of light per day. The feed consumption varied with the egg production, the highest producing group consuming the greatest amount of feed, and the lot having the lowest production the least amount of feed. It is interesting to note, however, that 3 hr of intermittent light per day resulted in a greater production than 10 hr of continuous light per day; also that the feed consumption was greater for the 3 hr of intermittent light per day than for the 10 hr of continuous light. The egg production for this test is shown by Fig. 2. The top curves show that 17 hr of light per day resulted in the highest production, while the pen having 24 hr was second, with the pen having 3 hr of intermittent light third, and the pen using 10 hr of continuous light fourth in egg production.

TABLE 2. EFFECT OF HOURS OF LIGHT PER DAY ON EGG PRODUCTION (OCT. 29, 1938, TO FEB. 18, 1939)

Pen No.	1	2	3	4
Kind of light	Mazda	Mazda	Mazda	Mazda
Light intensity at feed trough, ft-c	7.5	7.5	7.5	7.5
Hours of light per day	13	15	17	19
Avg feed consumption per bird for each 28-day period, lb	7.6	7.7	7.7	7.2
Avg gain or loss in body weight for 16 weeks, lb	+0.2	—0.1	+0.1	—0.5
Mortality (number of birds)	0	0	0	0







Effect of hours of light per day on egg production: Fig. 2 (Left) November 12, 1937, to May 28, 1938; Fig. 3 (Center) October 29, 1938, to February 18, 1939, and Fig. 4 (Right) April 15 to July 8, 1939, and July 8 to August 5, 1939

Results, Part II. Table 2 shows the effect of the number of hours of light per day on egg production for 13, 15, 17, and 19 hr per day. The average feed consumption for each pen is nearly the same, and the change in body weight is small. The egg production is shown by Fig. 3, and from the per cent production it is noted that there is considerable variation for several periods; however, they have the same general trend. The per cent total production shows the early variations, but during the latter part of the test there is no significant difference in the egg production. It was concluded from this test that there is no significant difference in egg production for 13, 15, 17, and 19 hr of Mazda light per day.

TABLE 3. EFFECT OF HOURS OF LIGHT PER DAY ON EGG PRODUCTION (APRIL 15 TO JULY 8, 1939)

Pen No.	1	2	3	4
Kind of light	Mazda	Mazda	Mazda	Mazda
Light intensity at feed trough, ft-c	7.5	7.5	7.5	7.5
Hours of light per day	7	9	11	13
Avg feed consumption per bird for each 28-day period, lb	6.4	6.4	7.5	7.8
Avg gain or loss in body weight for 4-week period, lb		Not recorded		
Mortality (number of birds)	2	1	1	0

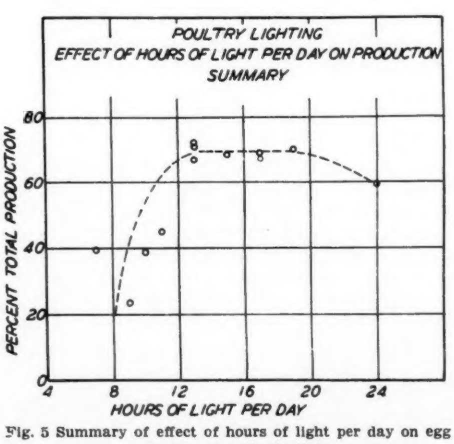


Fig. 5 Summary of effect of hours of light per day on egg production for Mazda light

Results, Part III. Table 3 shows the effect of 7, 9, 11, and 13 hr of light per day on egg production. The feed consumption varied with the egg production, the lowest producing group consuming the least amount of feed. The production is shown by Fig. 4, which shows that the 13 hr of light gave an increase in production, while 11, 9, and 7 hr gave a decrease in production.

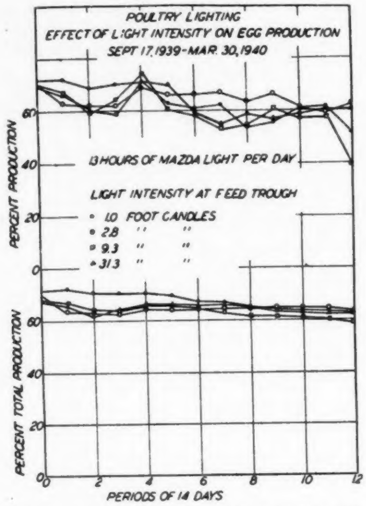
TABLE 4. EFFECT OF HOURS OF LIGHT PER DAY ON EGG PRODUCTION (JULY 8 TO AUGUST 5, 1939)

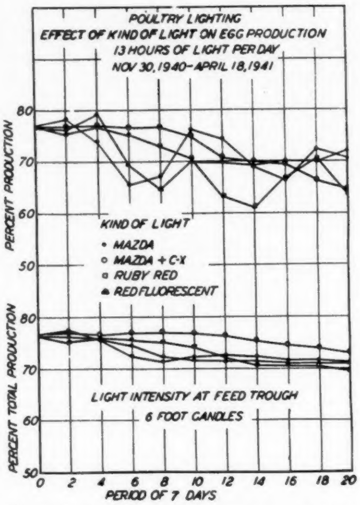
Pen No.	1	2	3	4
Kind of light	Mazda	Mazda	Mazda	Mazda
Light intensity at feed trough, ft-c	7.5	7.5	7.5	7.5
Hours of light per day	13	13	13	13
Avg feed consumption per bird for each 28-day period, lb	6.6	6.9	7.4	6.6
Avg gain or loss in body weight for 4-week period		Not recorded		
Mortality (number of birds)	1	0	0	0

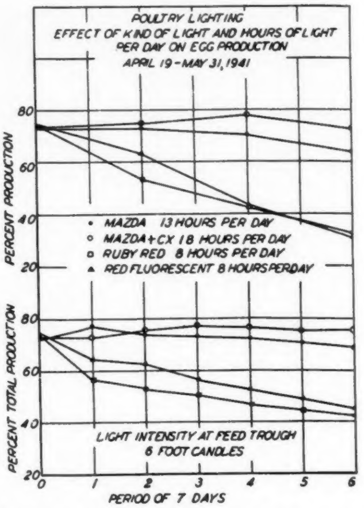
At the end of this test, Groups 1, 2, and 3 were stepped up to 13 hr of light per day. The results of this test are shown by Table 4. Feed consumption was approximately the same for each group. The egg production is shown by the latter part of Fig. 4. It was shown from these curves that the egg production for the group receiving 13 hr of light per day remained approximately the same, while the 11, 9, and 7-hr groups increased in production above that of the 13-hr group. From this test it was concluded that 7, 9, and 11 hr of Mazda light per day are not sufficient for high-producing birds. The production of birds receiving 7, 9, and 11 hr of Mazda light per day was definitely increased by subjecting the hens to 13 hr of light per day.

The effect of the hours of light per day on egg production for Mazda light is summarized by Fig. 5. It may not be justifiable to plot a curve from tests conducted over a period of four years with different birds each year. It does, however, show definitely that 13 hr of Mazda light per day are required for high-producing birds. Any decrease from 13 hr resulted in a decreased egg production. An increase from 13 to 19 hr did not result in an increased egg production. Continuous lighting seems to have a detrimental effect on egg production over that of 13 to 19 hr per day for high-producing hens.

Results, Part IV. Since many of the research workers in the poultry lighting studies have stated that the increase







Effect on egg production of light intensity (Fig. 6, left), of kind of light (Fig. 7, center), and of kind of light and hours of light per day (Fig. 8, right)

in egg production due to artificial light was caused by the stimulating effect of the light itself, it was thought that an increase in light intensity should give an increase in egg production. Our first tests have definitely showed that 13 hr of light per day is the minimum requirement for high-producing hens. A test was set up to determine the effect of light intensity on egg production. The same equipment was used as previously described, with the exception of the lamps. In Pen 1, six 7½-w bulbs were used, giving a light intensity of 1 ft-c (foot-candle) at the feed trough. Six 15-w bulbs were used in Pen 2, giving a light intensity of 2.8 ft-c at the feed trough. The light intensities for Pens 3 and 4 were, respectively, 9.3 and 31.3 ft-c at the feed trough.

TABLE 5. EFFECT OF LIGHT INTENSITY UPON EGG PRODUCTION (SEPT. 16, 1939, TO MARCH 2, 1940)

Pen No.	1	2	3	4
Kind of light	Mazda	Mazda	Mazda	Mazda
Light intensity at feed trough, ft-c	1.0	2.8	9.3	31.3
Hours of light per day	13	13	13	13
Avg feed consumption per bird for each 28-day period, lb	7.3	7.0	6.8	6.8
Avg gain or loss in body weight for 24 weeks, lb	+0.35	+0.27	+0.20	+0.40
Mortality (number of birds)	2	1	1	1

The effect of light intensity upon egg production is shown by Table 5 and Fig. 6. The feed consumption was essentially the same for all groups and the change in body weight was approximately the same, all birds having a normal gain. The egg production is shown by Fig. 6, from which it was concluded that there was no significant difference for birds receiving from 1 to 31 ft-c of Mazda light 13 hr per day. Higher intensities than those used in this test were deemed impractical because of the higher energy costs to maintain this intensity in the average poultry house.

Results, Part V. Some of the investigational work with various types and kinds of light indicate that certain types and colors of light result in an increase or decrease in egg production. With this in mind, a test was set up in the fall of 1940 to determine the effect of Mazda light, Mazda light plus CX light, ruby red light, and red fluorescent light. All groups were given 13 hr of light per day, the Mazda-lighted pen being used as the check group. The lights were arranged to give a light intensity of 6 ft-c at the feed trough. The Mazda light, Pen 1, was furnished by six 25-w lamps located above the pens. The Mazda plus CX, Pen 2, was equipped with Mazda lamps similar to Pen 1 with the addition of two rows of 250-w CX lamps, one row located on each side wall. The birds in this pen were subjected to 4 hr of CX light, from 6:00 to 10:00 a.m. The ruby red light, Pen 3, was furnished by two rows of six 100-w natural ruby lamps, one row located on each side wall. The red fluorescent light, Pen 4, was furnished by two rows of four 15-w red fluorescent tubes, one row being located on each side of the pen.

TABLE 6. EFFECT OF KIND OF LIGHT ON EGG PRODUCTION (NOV. 30, 1940, TO APRIL 18, 1941)

Pen No.	1	2	3	4
Kind of light	Mazda	Mazda plus CX	Ruby red	Red fluorescent
Light intensity at feed trough, ft-c	6	6	6	6
Hours of light per day	13	13	13	13
Avg feed consumption per bird for each 28-day period, lb	8.0	7.3	7.2	8.2
Avg gain or loss in body weight for 20 weeks, lb	+0.08	−0.04	−0.28	+0.17
Mortality (number of birds)	0	1	2	0

The effect of the kind of light on egg production from November 30, 1940, to April 18, 1941, is shown by Table 6 and Fig. 7. The feed consumption is essentially the same for all groups. Groups 2 and 3 lost weight, while groups 1 and 4 gained in weight. The egg production is shown by Fig. 7 which shows that all groups started at approximately the same production, and that each group during the period fell off in production and then came back to a high level. It was interesting to note that for each group a high production was maintained. For the 20-week period, the Mazda light plus 4 hr of CX light gave a production of 72.9 per cent, while the Mazda light gave a production of 71.2 per cent, the red fluorescent 71.0 per cent, and the ruby red 69.8 per cent. Although it appears that the Mazda light plus the CX light gave the best results, it was concluded that there was no significant difference between the Mazda light, Mazda light plus CX, ruby red, and red fluorescent, when the birds received 13 hr of light per day.

Since there was no significant difference between the various types of light used in the preceding test, it was decided to reduce the ruby red and the red fluorescent groups to 8 hr of light per day. The same set-up as described in the previous test was *(Continued on page 364)*

A Study of Old Farmer-Built Terraces

By Arvy Carnes and W. A. Weld
Member A.S.A.E. Member A.S.A.E.

THOUSANDS of acres of land have been terraced in the southeastern part of the United States during the past 50 years, and before the inception of coordinated soil conservation operations in the fall of 1933, this terracing work had been initiated and carried out for the most part by individual farmers. Some of the work was sponsored by various agricultural agencies through which limited assistance was given the farmer in surveying lines and familiarizing him with some form of construction technique. Supervision was lacking, however, and little thought was given to the stabilization of outlets, maintenance of the system, or coordinating the practice of terracing with other needed land-use adjustments. The thought generally prevailed that terracing was the answer to the erosion problem. Unfortunately, in many instances, the system was improperly planned and established, which resulted in an accelerated erosion process rather than a corrective measure.

It is an accepted fact that considerable advancement has been made in the past five or six years relative to erosion control technique. Experience has unquestionably proven that single-practice methods of attacking the problem are not adequate but that several practices must be properly coordinated to provide a complete conservation plan for the farm. Much has been learned through research findings and practical field experience in the specific field of terracing, as in other phases of the program. Terrace specifications have been strengthened and standardized within practical limits. Furthermore, the development of a complete water disposal plan for the drainage unit, with emphasis on outlet stabilization in advance of terracing, is now recognized as essential to sound planning and establishment.

Technicians in direct contact with the field operations have realized that much of the terracing work initiated prior to 1933 was not satisfactory and should be replanned and established in accordance with approved standards. In order that factual data might be available to substantiate or disprove this conviction, an extensive study has been made to evaluate the adequacy of old terracing systems.

Paper presented before the Soil and Water Conservation Division at the fall meeting of the American Society of Agricultural Engineers at Chicago, December 1940. Authors: Respectively, chief, and associate agricultural engineer, Regional Engineering Division (Region 2), Soil Conservation Service, U. S. Department of Agriculture.

The study was initiated by the regional engineering division of the U. S. Soil Conservation Service, Region 2, in the spring of 1940.* Area engineers in the region were given a supply of schedules to be used in providing a standard form for recording the data obtained in the field. The instructions were as follows:

1 A limited number of studies to be made by the local technicians in each work unit where an appreciable volume of terracing work has been carried out in the past by the farmer

2 Fields to be carefully selected which would be representative of conditions generally found in that locality

3 Each study to be evaluated on a field basis using one schedule for each field

4 An accurate and unbiased appraisal to be made in each case, so that factual data would be revealed.

Data were collected from the states of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi. No attempt was made to obtain records from Virginia, due to the comparatively small volume of farmer-terracing operations undertaken in that state which would be applicable to the study.

Scope of the Study. A total of 524 terraced fields comprising 14,257 acres were included in the study. The fields ranged in size from 3 to 200 acres and averaged 27 acres per field.

*J. M. Downing and E. A. Schlaudt, assistant chiefs of Region 2, assisted in the preparation of the schedule for this study and offered valuable suggestions in connection with the preparation of this paper.

TABLE 1. DISTRIBUTION OF STUDIES BY STATES

State	Number of studies (fields)	Per cent of total
Georgia	206	39
Alabama	119	23
South Carolina	71	14
Mississippi	65	12
North Carolina	48	9
Florida	15	3
Total	524	100

The authors of the accompanying paper point out that experience has unquestionably proven that single-practice methods of attacking the erosion-control problem are not adequate, but that several practices must be properly coordinated to provide a complete conservation plan for a particular farm. Also, technicians in direct contact with field operations have realized that much of the terracing work prior to 1933 was not satisfactory and should be replanned and established in accord with approved standards

A review of the data in Table 2 shows that 89 per cent of the studies were conducted on soils classified as red to brown loams and clay loams or grey to brown sandy loams and silt loams. Considering distribution from the standpoint of soil provinces, Coastal Plain and Piedmont Soils constitute 84 per cent of the total. The major soil types represented were Ruston Sandy Loam, Cecil Sandy Loam, Norfolk Sandy Loam, Tifton Sandy Loam, Appling Sandy Loam, and Cecil Clay. These soils comprise over 52 per cent of the total area represented.

TABLE 2. SUMMARY OF DATA ON BASIS OF SOIL PHYSICAL CHARACTERISTICS AND SOIL PROVINCES

ACCORDING TO SOIL PHYSICAL CHARACTERISTICS			ACCORDING TO SOIL PROVINCES		
Group*	No. of studies (fields)	Per cent of total	Province	No. of studies (fields)	Per cent of total
2	86	16	Coastal plain	259	50
3	384	73	Piedmont	180	34
4	6	1	Foothills	5	1
5	35	7	Limestone valley	27	5
6	9	2	Shales and sandstones	34	6
7	4	1	Loess	14	3
			Black belt	5	1
Total	524	100	Total	524	100

*Grouping based on Land-Use Capability Classifications Adopted for this Region:
Group 2 — Red to brown loams and clay loams
Group 3 — Gray to brown sandy loams and silt loams
Group 4 — Soils with imperfect drainage
Group 5 — Soils having plastic subsoils
Group 6 — Soils with little natural surface or subsoil development
Group 7 — Loamy sands and sands.

TABLE 3. ANALYSIS OF LAND SLOPE CONDITIONS

LAND SLOPE		
Slope, per cent	Number of studies (fields)	Per cent of total
0 to 2	0	0
2 to 3	6	1
3 to 4	31	6
4 to 5	58	11
5 to 6	83	16
6 to 7	77	15
7 to 8	66	12
8 to 10	100	19
Above 10	103	20
Total	524	100

The distribution of studies according to slope classification as shown in Table 3 appears to be representative of conditions normally found in the Southeast. A slope of 10 per cent is generally considered the safe upper limit for terracing; however, slopes exceeding that amount were found on 20 per cent of the fields represented in the study. In compiling the data no attempt was made to correlate slope with horizontal spacing by individual studies. Nevertheless one pertinent conclusion can be drawn from the data presented in Table 4. Horizontal spacing of terraces exceeded 100 ft on 22 per cent of the fields, whereas, based on approved spacing recommendations, only 1 per cent of the total had field slopes which would allow a horizontal spacing greater than 100 ft.

TABLE 4. ANALYSIS OF TERRACE SPACING

HORIZONTAL SPACING OF TERRACES		
Spacing, ft	No. of studies (fields)	Per cent of total
Over 200	8	2
150 to 200	11	2
100 to 150	93	18
90 to 100	15	3
80 to 90	65	12
70 to 80	64	12
60 to 70	81	15
50 to 60	115	22
Under 50	72	14
Total	524	100

Evaluation of Water-Disposal Plans. Of the 524 fields studied, only 74, representing 14 per cent of the total, had properly planned water-disposal systems. The acreage of these fields amounted to 1,862 acres, or 13 per cent of the total area. On the basis of these figures the average-size properly planned field was 25 acres, compared with approximately 28 acres per unit for improperly planned fields. The data in Table 5 show the relation between properly and improperly planned fields by states.

TABLE 5. EVALUATION OF WATER-DISPOSAL PLANNING BY STATES

	Properly planned		Not properly planned	
State	No. of studies (fields)	Per cent of studies obtained	No. of studies (fields)	Per cent of studies obtained
Georgia	33	16	173	84
Alabama	25	21	94	79
South Carolina	5	7	66	93
Mississippi	5	8	60	92
North Carolina	4	8	44	92
Florida	2	13	13	87
Total	74	14	450	86

Several fundamental factors were considered in evaluating the technical excellence of water-disposal plans. These factors are shown in Table 6. From these data it is evident that outlets were improperly located on 54 per cent of the fields studied. Of equal importance is the fact that in 49 per cent of all cases the terraces were planned with excessive grades.

TABLE 6. FACTORS CONTRIBUTING TO IMPROPER PLANNING

	Not properly planned		
Contributing factor	No. of studies (fields)	Per cent	Per cent of total studies
Improper location of outlets	284	63	54
Water carried across natural draws	219	49	42
Terraces too long	163	36	31
Headwater drainage not diverted	100	22	19
Excessive terrace gadient (over 6 in/100 ft)	257	57	49

Terrace Gradient. Since terrace gradient was considered as a factor in evaluating the quality of plans, it is interesting to observe a further breakdown of this variable to determine the range of terrace grades actually found. Assuming a 6-in maximum allowable gradient, a review of the data in Table 7 shows that 57 per cent of the improperly planned fields had terrace grades exceeding that amount. Furthermore, 10 per cent of all fields had level terraces.

TABLE 7. ANALYSIS OF TERRACE GRADIENTS

	Properly planned		Not properly planned		Total	
Grade, in/100 ft	No. of fields	Per cent	No. of fields	Per cent	No. of fields	Per cent
Level	5	7	46	10	51	10
1 to 2	7	9	20	4	27	5
2 to 4	37	50	75	17	112	22
4 to 5	10	14	34	8	44	8
5 to 6	15	20	18	4	33	6
Maximum Allowable Gradient						
6 to 9	—	—	96	21	96	18
9 to 12	—	—	31	7	31	6
12 to 18	—	—	79	18	79	15
Above 18	—	—	51	11	51	10
Total	74	100	450	100	524	100

Channel Cross Section. From an analysis of the data in Table 8, it is evident that the cross section of the majority of the terraces is inadequate. A terrace channel cross section of 6 sq ft is considered as the minimum required to insure proper functioning of the terrace. From the data it is obvious that 86 per cent of (*Continued on page 366*)

Electric Light for Egg Production

(Continued from page 360)

used. The Mazda plus the CX group was stepped up to 18 hr per day for the Mazda and 8 hr for the CX. Results of this test are shown by Table 7 and Fig. 8. The feed consumption was slightly higher for groups 1 and 4, while groups 2 and 3 were essentially the same. The body weights were all less for the 6-week period. The weight change for Pen 1 was not significant, and the loss in weight for Pen 2 was attributed to exceptionally high production.

TABLE 7. EFFECT OF KIND OF LIGHT AND HOURS OF LIGHT ON EGG PRODUCTION (APRIL 19 TO MAY 31, 1941)

Pen No.	1	2	3	4
Kind of light	Mazda	Mazda plus CX	Ruby red	Red fluorescent
Hours of light per day	13	18	8	8
Avg feed consumption per bird for each 28-day period, lb	9.1	7.4	6.5	6.6
Avg gain or loss in body weight for 6-week period, lb	—0.09	—0.43	—0.34	—0.20
Mortality (number of birds)	1	0	0	0

The weight loss for groups 3 and 4 was attributed to insufficient hours of light, resulting in nine birds in group 3 and 10 birds in group 4 going into a molt during the 6 weeks.

The egg production is shown in Fig. 8. The production in the pen using 13 hr of Mazda light continued about the same as that of the previous test, about 70 per cent egg production. Increasing the Mazda plus CX light to a total of 18 hr per day gave a short stimulus in production after which the birds settled down to approximately 70 per cent production. The ruby red and red fluorescent groups, when cut to 8 hr a day, dropped off in production rapidly. These groups both started at 74 per cent, but at the end of the 6-week period their production had dropped to about 32 per cent. Production for the sixth week for Pen 3 was 31.4 per cent and for Pen 4, 26.4 per cent. From this test it is concluded that 8 hr of ruby red or red fluorescent light is not sufficient to maintain birds at high production.

CONCLUSIONS

From the tests thus far completed, the following conclusions are drawn:

1 Thirteen hours of Mazda light per day is the minimum requirement for high-producing hens. Any decrease in hours of light per day results in a decreased production. Increases from 13 to 19 hr of light per day do not result in an increased egg production.

2 There is no significant difference in the effect of light intensities varying from 1.0 to 31.3 ft-c on egg production, provided the hens receive 13 hr of Mazda light per day.

3 There is no significant difference in the effect of Mazda, Mazda plus CX, ruby red, and red fluorescent light on egg production, provided the birds receive 13 hr of light per day.

4 Eight hours of ruby red and red fluorescent light per day are insufficient to maintain birds at a high rate of egg production.

5 Any results reported on artificial lighting for egg production must be conducted under carefully controlled conditions in order to eliminate variable factors; and should be run for a sufficient length of time to get an accurate indication of the production records.

ACKNOWLEDGMENTS: The authors wish to express their appreciation to Mr. Harry L. Garver, who helped organize this project, and to Mr. W. A. Junnila, who succeeded Mr. Garver. Both Mr. Garver and Mr. Junnila are former investigators for the Washington C.R.E.A.

Publications on Gully Erosion Control

THE A.S.A.E. Subcommittee on the Control of Gully Erosion herewith offers to Society members an approved list of the best current publications on the subject of gully erosion control. During the past two years the Committee has spent considerable time and effort in formulating recommended procedures, since it was felt that adequate planning is a prime factor toward successful gully control.

However, in delving into the actual methods of gully control, the Committee was faced with the task of gleaning from numerous publications the basic methods of what constitutes economical and practical control. Perusal of the better publications emphasizes clearly that fundamentally the principles of such control are few and well defined. Modification is necessary only to meet the needs of the various localities.

Considering these above facts, and at the same time bearing in mind that agricultural engineers are in need of publications that are readily available and currently revised, the Committee presents the following as a list of worthwhile publications on the subject:

Cover Crops for Soil Conservation. U.S.D.A. Farmers' Bulletin No. 1758, 14 pp., July 1936, 5c.

Crops Against the Wind on the Southern Great Plains. U.S.D.A. Farmers' Bulletin No. 1833, 74 pp., December 1939, 10c.

Erosion on Roads and Adjacent Lands. U.S.D.A. Leaflet No. 164, 8 pp., September 1938, 5c.

Mulching to Establish Vegetation on Eroded Areas of the Southeast. U.S.D.A. Leaflet No. 190, 8 pp., revised December 1940, 5c.

Native and Adapted Grasses for Conservation of Soil and Moisture in the Great Plains and Western States. U.S.D.A. Farmers' Bulletin No. 1812, 44 pp., February 1939, 10c.

Prevention and Control of Gullies. U.S.D.A. Farmers' Bulletin No. 1813, 59 pp., September 1939, 10c.

Soil-Depleting, Soil-Conserving, and Soil-Building Crops. U.S.D.A. Leaflet No. 165, 8 pp., September 1938, 5c.

Stock-Water Developments, Wells, Springs, and Ponds. U.S.D.A. Farmers' Bulletin No. 1859, 70 pp., July 1940, 10c.

Strip Cropping for Soil Conservation. U.S.D.A. Farmers' Bulletin No. 1776, 40 pp., revised July 1939, 5c.

Terrace Outlets and Farm Drainageways. U.S.D.A. Farmers' Bulletin No. 1814, 46 pp., July 1939, 10c.

Terracing for Soil and Water Conservation. U.S.D.A. Farmers' Bulletin No. 1789, 60 pp., April 1938, 10c.

Working Plans for Permanent Farms. U.S.D.A. Miscellaneous Publication No. 411, 41 pp., October 1940, 15c.

Recommendations for the Control and Reclamation of Gullies. Iowa Engineering Experiment Station Bulletin No. 121, 71 pp., illustrated, 1925.

Using Soil Binding Plants to Reclaim Gullies in the South. U.S.D.A. Farmers' Bulletin No. 1697, 18 pp., illustrated, 1933.

The Use of Bluegrass in the Control of Soil Erosion. U.S.D.A. Farmers' Bulletin No. 1760, 13 pp., illustrated, 1936.

It will be noted that the publications listed do not always apply directly to gullies, but they do cover related phases of control. The Committee feels that in the past too much emphasis has been placed on the gully rather than on the other factors contributing toward the formation of that gully. These should be studied in conjunction with the methods pertaining to the gully itself.

The Committee believes that there is one phase of gully control that has not as yet been adequately solved, namely, the economical and practical control of gullies in the arid and semiarid parts of the United States. There are no publications to our knowledge that discuss the subject with any degree of understanding. We would recommend that, for the coming year, the Committee investigate further this phase of gully control.

A contribution of the Subcommittee on Control of Gully Erosion (of the A.S.A.E. Committee on Soil Erosion) —H. G. Jepson (chairman), M. W. Clark, Howard Matson, J. D. Parsons, I. D. Wood.

A Study of Old Farmer-Built Terraces

(Continued from page 362)

the improperly planned fields had channel capacities under 6 sq ft, whereas, 58 per cent of the properly planned units had inadequate channel cross sections.

TABLE 8. ANALYSIS OF TERRACE CHANNEL CROSS SECTION

Terrace channel cross section, sq ft	Properly planned: No. of fields	Properly planned: Per cent	Not properly planned: No. of fields	Not properly planned: Per cent	Total: No. of fields	Total: Per cent
0 to 2	10	14	88	20	98	19
2 to 3	6	8	79	17	85	16
3 to 4	6	8	97	22	103	20
4 to 5	9	12	79	17	88	17
5 to 6	12	16	47	10	59	11
Minimum Allowable Channel Cross Section						
6 to 7	11	15	25	6	36	7
7 to 8	8	11	8	2	16	3
8 to 10	9	12	13	3	22	4
Above 10	3	4	14	3	17	3
Total	74	100	450	100	524	100

Cultural and Tillage Practices. Any system of terraces, no matter how well designed and constructed, must receive proper attention; otherwise the terraces will soon deteriorate to a point where they become a liability rather than an asset. Certain practices are required in order to insure the continued maintenance of the system. Chief among these are proper terrace maintenance by plowing, contour tillage, the use of close-growing crops in rotations, and the stabilization of critical slopes within or adjacent to terraced fields through the use of perennial vegetation. The analysis of the data in Table 9 provides a summary of the findings relative to the application of these measures.

The evaluation of terrace maintenance on the basis of properly planned and improperly planned fields provides an interesting comparison. The trend in the former was toward good maintenance, whereas the opposite was indicated for the improperly planned units. This trend logically follows and substantiates the finding previously summarized relative to terrace channel capacities for the two classes of studies. A much smaller number of unprotected critical areas were found to be contributing to damage of the system on properly planned fields than on the improperly planned units. Table 9 shows this difference to be 12 per cent as compared to 47 per cent for the respective classes. Tillage and cropping practices appear to follow a similar trend on both classes.

TABLE 9. SUMMARY OF CULTURAL AND TILLAGE PRACTICES

Practice	Properly planned: No. of fields	Properly planned: Per cent	Not properly planned: No. of fields	Not properly planned: Per cent	Total: No. of fields	Total: Per cent
Terrace maintenance						
Poor	20	27	202	45	222	42
Fair	23	31	192	43	215	41
Good	31	42	56	12	87	17
Contour tillage followed (rows paralleling terraces)	72	97	412	91	484	92
Approved crop rotations	23	31	158	35	181	34
Continuous row crops	51	69	292	65	343	66
Unprotected critical areas contributing to terrace failure	9	12	214	47	223	43

Performance of Water-Disposal Systems. In the final analysis the performance of the system provides the only logical basis for evaluating its effectiveness. A number of factors having a direct bearing on performance were considered in making the study and these are summarized in Table 10. Channel scouring was evident on 57 per cent of the fields which were improperly planned. This trend is revealing since a review of the data in Tables 6 and 7 shows likewise that 57 per cent of the fields falling in this classification had terrace gradients exceeding 6 in per hundred feet. Outlets were not stabilized on 80 per cent of the improperly planned units as compared to 43 per cent not stabilized for those which were properly planned.

TABLE 10. FACTORS CONTRIBUTING TO FAULTY PERFORMANCE

Contributing factor	Properly planned: No. of fields	Properly planned: Per cent	Not properly planned: No. of fields	Not properly planned: Per cent	Total: No. of fields	Total: Per cent
Terrace channel scouring	11	15	255	57	266	51
Terrace overtopping	32	43	281	62	313	60
Terrace channel obstructed	9	12	133	30	142	27
Outlet end of terraces restricted	15	20	113	25	128	24
Terrace outlets not stabilized	32	43	362	80	394	75

SUMMARY

1 The study was conducted for the purpose of obtaining factual data relative to the technical quality and effectiveness of old farm-built terraces in the Southeast.

2 Fields were selected for study which were considered to be representative of conditions generally found in the locality. Studies were evaluated on a field basis.

3 A total of 524 terraced fields, comprising 14,257 acres, were included in the study.

4 From the data presented, the water disposal was properly planned on only 14 per cent of the fields. Generally, the fields in this group were smaller and would require less difficult planning than larger fields.

5 On the fields on which the water-disposal systems were improperly planned, the following conditions were found: Improper location of outlets, 63 per cent; excessive terrace gradient, 57 per cent; water carried across natural draws, 49 per cent; terraces too long, 36 per cent; headwater drainage not diverted, 22 per cent.

6 Terrace channel capacity was found to be below accepted standards on 83 per cent of all fields studied. Likewise, terrace maintenance was inadequate on 83 per cent of the fields, which apparently accounts in large measure for the former condition.

7 In 92 per cent of all cases the terraces were used as guides for row layout, indicating attempt to obtain contour cultivation. However, (from category 5 above) more than 50 per cent of the row grades would appear to be excessive.

8 Crop rotations (usually 2-year) were practiced on 34 per cent of the fields studied, whereas continuous row crops were indicated on the remaining 66 per cent.

9 Unprotected critical areas were found to be contributing to terrace failures on 43 per cent of all fields studied.

10 Terrace channel scouring was indicated on 57 per cent of the improperly planned fields, a condition which is revealing and might be expected since a similar percentage of fields in that group had terrace gradients exceeding 6 in per 100 ft.

11 Other causes of the improper performance of terraces were: Terraces overtopping, 60 per cent; terrace outlets not stabilized, 75 per cent; terrace channel obstructed, 27 per cent; outlet end of terraces restricted, 24 per cent.

12 From the analysis of the data herein presented, the majority of terraced fields represented in this study have not been properly planned, nor have the practices been established and maintained according to accepted standards. For those fields, comprising 14 per cent of the total, upon which the water-disposal systems were properly planned, corrective measures may be initiated to adjust the systems so that they will meet accepted standards. However, for the majority of the fields represented in the study, major revision will be necessary, owing to the fact that the basic design is incorrect.

NEWS

Fall Meeting at Chicago

THE Fall Meeting of the American Society of Agricultural Engineers will be held as usual at The Stevens Hotel, Chicago, during the week of the International Livestock Exposition—December 1, 2, and 3. The time of the meeting this year is to be limited to three days instead of the usual four, and instead of two divisions holding concurrent sessions on the first two days and two other divisions on the third and fourth days, the program of all four technical divisions of the Society—Power and Machinery, Rural Electric, Farm Structures, and Soil and Water Conservation—will be spread over a period of three days, but there will not be more than two concurrent sessions at any one time.

Under this arrangement all who are mainly interested in the program of a particular division, will be in attendance at the meeting at the same time, and will have the opportunity of attending the programs of other divisions, and thereby get a better idea of activities in other branches of agricultural engineering, as well as have the opportunity of extending their acquaintance among specialists in those branches. This arrangement also makes it easier to arrange joint sessions of one or more divisions where they have a more or less common interest in a particular subject.

A new feature of the meeting this year will be a Society dinner to be held the evening of Tuesday, December 2. Not more than two talks are being scheduled for this dinner, the purpose of which is mainly to give those in attendance at the meeting a better opportunity to become acquainted.

The forenoon of Monday, December 1, will feature concurrent programs of the Power and Machinery Division and the Farm Structures Division, while Monday afternoon is set aside for a special program being sponsored by the Committee on Research.

Tuesday forenoon, December 2, will be given over to concurrent programs of the Soil and Water Conservation Division and a joint program of the Farm Structures and Rural Electric Divisions. Tuesday afternoon will feature separate programs of all four divisions. These sessions will be limited to two hours each, and only two sessions will be going on at the same time.

On Wednesday forenoon, December 3, the Power and Machinery and Soil and Water Conservation Divisions will present a joint program which will run concurrently with a program of the Rural Electric Division. On Wednesday afternoon the Power and Machinery Division will present a program concurrently with the Farm Structures and the Rural Electric Divisions.

Meetings Chairman A. W. Turner and Division Chairmen A. J. Schwantes, A. V. Krewatch, G. B. Hanson, and H. S. Riesbol have been engaged in plans for the meeting for more than two months and not only have most of the subjects been selected, but also nearly all the speakers. It is expected the program in practically final form will be ready not later than November 1.

The Fourth Industry Seminar

THE first Industry Seminar sponsored by the American Society of Agricultural Engineers with the cooperation of six companies of the farm equipment industry was held in 1938. The fourth seminar was held last month, September 3 to 10, inclusive.

The group on tour with the 1941 Industry Seminar consisted of 116 persons made up largely of junior and senior students in agricultural engineering at state colleges and universities and the staff members of agricultural engineering departments. The group also included a number of faculty representatives of farm management departments, four deans and one assistant dean of agriculture, one dean of engineering, one director and one assistant director of agricultural extension, one representative of the U. S. Department of Agriculture, and two Latin-American representatives (Mexico and Brazil). Thirty-two states and two provinces of Canada were represented by the seminar group.

Six companies of the farm equipment industry cooperated with the Society in sponsoring the Seminar this year, including Allis-Chalmers Mfg. Co., Caterpillar Tractor Co., Deere & Co., International Harvester Co., Minneapolis-Moline Power Implement Co., and Oliver Farm Equipment Co. The seminar group spent a day as the guests of each company, where they were shown a wide variety of interesting and informative factory operations in the production of modern farm tractors and other machines and implements.

The principal features of each day's program included talks by key men of the different companies dealing with the engineering, manufacturing, distribution, and servicing phases of the farm equipment industry. The talks together with trips to the factories were particularly interesting and gave the group an excellent insight into the problems and methods of producing farm machinery. In the space of one week, students and instructors received practical education in recent developments of the most up-to-date methods in the agricultural equipment industry, which would be impossible to obtain in any other way in so short a time.

Frank J. Zink of the Farm Equipment Institute acted as special representative of the participating companies and had charge of transportation and accommodations. R. U. Blasingame of Pennsylvania State College, chairman of the A.S.A.E. Industry Seminar Committee, represented the Society. The Society was also represented on the trip by its president, Geo. W. Kable, editor of "Electricity on the Farm."

Many flattering comments have been received from those who attended the Seminar, and the Society is very much indebted to those cooperating companies who made it possible to carry out this very worth-while activity.

A.S.A.E. Meetings Calendar

December 1 - 3—Fall Meeting, Stevens Hotel, Chicago.

February 4 - 6—Southern Section, Gayoso Hotel, Memphis, Tenn.

June 22 - 25—Annual Meeting, Hotel Schroeder, Milwaukee.

Research Dairy Barn Dedicated

ON SEPTEMBER 25 at the University of Wisconsin was dedicated a new research dairy barn which was built by the Carnegie-Illinois Steel Corporation and loaned to the University for experimental purposes. During the dedication ceremony it was pointed out that it requires about as long to care for a dairy cow today as it did in the day of the walking plow and grain cradle, and that one of the principal aims of the research to be carried on in the new research barn will be to discover ways and means of increasing labor efficiency in caring for the dairy cow.

It is expected it will take several years to get the answer, but in the meantime agricultural engineers and other specialists who are concerned with dairy production problems, including practical dairymen and the manufacturers of structural and other equipment used in dairy production, will watch the progress of the research carried on in connection with the new barn with a great deal of interest.

Necrology

Egbert Forbs Redding, extension agricultural engineer, New Mexico College of Agriculture, was killed in an automobile accident near Roswell, N. Mex., on August 29. Mr. Redding was a native of Texas, and graduated with the bachelor's degree in agricultural engineering from the A. & M. College of Texas in 1936.

On graduation he entered the employ of the Texas Agricultural Extension Service, and during this employment he was made AAA secretary at Clarindon, Texas, and later was assistant county agricultural agent at Channing, Texas, where he had charge of field work in terracing and range conservation.

In September 1939 Mr. Redding entered the employ of the New Mexico Agricultural Extension Service as agricultural engineer in charge of specialized work in agricultural engineering, assisting county agricultural agents in planning and carrying out demonstrations of an agricultural engineering nature.

(News continued on page 370)

Personals of A.S.A.E. Members

Leonard W. Bonhorst recently accepted appointment as junior agricultural engineer with the Bureau of Reclamation, U. S. Department of the Interior. He will be located at Guernsey, Wyo., and will engage in experimental work in connection with water and moisture losses from irrigation ditches.

Wansley H. Cox has accepted a position as research associate on the agricultural engineering staff of the University of Georgia, Athens. He was previously research fellow in agricultural engineering at Iowa State College.

Roy D. Crist holds a commission as first lieutenant in the U. S. Army Air Corps and is now on duty at Randolph Field, Tex.

John W. Holliday has recently been appointed a junior soil conservationist, U. S. Soil Conservation Service, and is located at Greenville, Ga.

A. Clark Hudson has resigned as architectural designer of the U. S. Bureau of Agricultural Chemistry and Engineering to engage in private architectural practice with James A. Clark, architect, Masonic Building, Winchester, Ky.

William Kalbfleisch, lecturer in agricultural engineering at Macdonald College, recently resigned to accept appointment as agricultural scientist in the field husbandry division of the Central Experimental Farm of the Department of Agriculture of Canada, in which he will be engaged in research and publication work in the agricultural engineering section.

Harry B. Pfost has resigned his position with the Rural Electrification Administration to accept appointment as assistant professor of agricultural engineering at Alabama Polytechnic Institute, Auburn.

W. J. Promersberger recently resigned from the agricultural engineering staff of Kansas State College to become chairman of the agricultural engineering department at North Dakota Agricultural College, Fargo.

W. C. Wheeler has resigned as instructor in the Georgia Vocational and Training School at Walker Park to accept appointment as instructor in farm mechanics in the agricultural engineering department at the University of Tennessee.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the September issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Leslie A. Buse, supervisor of repairs, Equitable Life Insurance Society of the United States. (Mail) 2238 Meadowbrook Drive, S.E., Cedar Rapids, Iowa.

John M. Chambers, engineer, Ferguson-Sherman Mfg. Corp., Dearborn, Mich. (Mail) 21716 Garrison Ave.

Leland O. Hanson, instructor, agricultural engineering department, West Central School and Station, Morris, Minn.

Charles R. Little, conservation and flood control engineer, Portland Cement Association. (Mail) 6840 Grace Ave., Silverton, Ohio.

Ausmus S. Marburger, agricultural engineer, New Holland Machine Co., New Holland, Pa.

Gordon W. Maston, Roy, Mont.

John T. Murphy, draftsman, Allis-Chalmers Mfg. Co. (Mail) 326 7th St., N., LaCrosse, Wis.

Lymon L. Roberts, engineering aide, Wolf Creek Ordnance Plant, Milan, Tenn. (Mail) Henderson, Tenn.

Cecil H. Robinson, agricultural engineering department, Purdue University, West Lafayette, Ind. (Mail) 202½ Chauncey Ave.

Claude B. Solterbeck, 2nd Lieut., Co. "C", 18th Engineers, Vancouver Barracks, Wash.

Harry Stierli, junior mechanical engineer, Western Regional Research Laboratory, Bureau of Chemistry and Engineering, U. S. Department of Agriculture. (Mail) Room 301, Agate Apts., 635 Ellis St., San Francisco, Calif.

Ernest L. Streb, junior agricultural engineer, Soil Conservation Service, U. S. Department of Agriculture. (Mail) Box 92, Yoakum, Tex.

TRANSFER OF GRADE

Loren W. Neubauer, assistant professor and assistant agricultural engineer in the experiment station, University of California, Davis, Calif. (Associate to Member)

Agricultural Engineering Digest

A review of current literature by R. W. TRULLINGER, assistant chief, Office of Experiment Stations, U. S. Department of Agriculture. Copies of publications reviewed may be procured only from the publishers at the addresses indicated.

INFILTRATION OF WATER INTO THE SOIL: A LIST OF REFERENCES RELATIVE TO THE PHYSICAL ASPECTS OF THE PRINCIPAL FACTORS AFFECTING THE RATE AND ITS MEASUREMENT, *J. M. Davidson.* U. S. Dept. Agr. (Washington), Soil Conserv. Serv. Bibliog. 3 (1940), pp. [4]+76. References arranged alphabetically by authors are concerned, with but few exceptions, with the capacity for and the rate and quantity of infiltration, papers not dealing with measurement or calculation of such data being, for the most part, omitted from the list. Each reference is accompanied by a brief indication of the nature of the cited material.

PLOWING FOR TERRACE MAINTENANCE IN THE SOUTH, *J. M. Downing and P. M. Price.* U. S. Dept. Agr., Soil Conserv. Serv., 1940, pp. [11], figs. 8. It is recommended that terrace maintenance be made a part of the regular tillage operations rather than a separate job. When land is prepared by flat breaking or complete plowing, terrace maintenance becomes a part of land preparation at no extra cost. Farming practices on terraced fields should also be adjusted so that not only the terraces but also the intervals between terraces are protected. One-land and two-land plowing and the use of the one-way disk tiller are among the methods discussed.

EXPERIMENTS IN THE USE OF VAPOR-SPRAY EQUIPMENT, *O. K. Hedden and R. M. Merrill.* (Coop. Ohio and Mich. Expt. Stas.) U. S. Dept. Agr. Cir. 598 (1940), pp. 20, figs. 7. An oil-fired commercial vapor-cleaning unit was adapted for vapor spraying of insecticides and fungicides. Dimensions of parts for many of the necessary alterations are stated, and the changes and additions are described in detail.

In comparative tests of the effectiveness of the vapor-spraying apparatus and conventional hydraulic-spraying equipment, a few materials were more effective when applied in a vapor spray, but many were less effective. Sulfurs seem to be particularly adapted to application by the vapor sprayer. Within the scope of the experiments made, it is concluded that the use of vapor spray as an insecticide or fungicide carrier is apparently limited to special cases requiring the application of fixed nicotines or sulfurs. Sulfur sprays, especially, adhered better when thrown by the vapor sprayer. Free nicotine, phenothiazine, and bordeaux mixtures, on the other hand, suffered serious deterioration when projected by vapor spraying. The quantity of water required was reduced by from one-third to one-half as compared with that used in hydraulic spraying, but the added cost of the necessary oil heat practically offset this saving, leaving the cost of the two methods, with correct operation of the equipment, about the same.

SPRINKLED PLAT RUN-OFF AND INFILTRATION EXPERIMENTS ON ARIZONA DESERT SOILS, *E. L. Beutner, R. R. Gaebe, and R. E. Horton.* (Coop. Ariz. Expt. Sta.) U. S. Dept. Agr., Soil Conserv. Serv., 1940, SCS-TP-38, pp. [2]+30, figs. 15. The original purposes of the experiments here reported upon were the determination of the infiltration capacities of southern Arizona range land and watershed soil types and the evaluation of the influences of surface-soil conditions, native cover, and management upon erosion and infiltration. It was found, from the outset, however, that hydrographs were well suited for an analysis, giving results in good agreement with those of analyses of surface runoff from the plats. Each experiment was, therefore, so carried out as to furnish complete hydrological data in addition to any other required information. The authors report and discuss 94 separate artificial rainfall applications of known amount (inches of total precipitation) and intensity (inches per hour) on plats 6 by 24 ft. The runoff was collected by means of an end plate and collecting trough at the lower end of each plat and was determined in calibrated measuring tanks. Runoff rates were determined by accurate timing of runoff increments. This volumetric method was found to be more accurate than the use of a small flume since, although the flume would measure instantaneous runoff rates, interference by debris and silt and difficulty in obtaining an adequate number of readings during rapid rise or fall of runoff rate would render the flume method undependable. Full description and photographic illustrations of the set-up are included with the report.

WEATHERPROOFING AND FIREPROOFING STUDIES ON WOOD AT THE WEST VIRGINIA STATION. West Virginia Agrl. Exp. Sta. (Morgantown) Bul. 298 (1940), p. 35, fig. 1. A brief note of work by H. D. Erickson on effects of fireproofing chemicals on the swelling and strength of woods indicates that some of the substances applied affected the properties named favorably, whereas some others had an opposite effect. *(Continued on page 374)*

Agricultural Engineering Digest

(Continued from page 372)

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE NEW MEXICO STATION. New Mexico Sta. (State College) Rpt. 1940, pp. 72-74. These included duty-of-water investigations and work on rate and cause of rise of ground water in the Mesilla Valley.

ENGINEERING INVESTIGATIONS AND OPERATIONS OF THE SOIL CONSERVATION SERVICE. U. S. Dept. Agr. (Washington), Soil Conserv. Serv. Rpt. 1940, pp. 37-38, 39-40, 52-54, 56-58. Demonstration and instruction in the use of farm equipment for conservation work, planning of more than 36,000 miles of terraces and diversions for the protection of approximately 500,000 acres, erosion-control work on highways, expansion of drainage work, technical assistance to farmers in improved irrigation methods, work on the Florida Everglades project, and the preparation and distribution of engineering handbooks to provide specifications and standardization for satisfactory field construction work on submarginal land are briefly reported, together with work on the development of small water facilities in the arid and semiarid sections of the country, hydrologic studies, sedimentation studies, drainage investigations, and irrigation investigations.

AGRICULTURAL ENGINEERING INVESTIGATIONS OF THE BUREAU OF AGRICULTURAL CHEMISTRY AND ENGINEERING. U. S. Dept. Agr. (Washington), Bur. Agr. Chem. and Engin. Rpt., 1940, pp. 63-80. Chemical engineering research covered agricultural fires dust explosions, and service work. Farm-structures research dealt with farmhouses, potato storage, farm-building plan service, silage-pressure studies, corn storage, wheat storage, and grain-sorghum storage. Farm mechanical equipment work was concerned with pest-control equipment and methods, fertilizer-distributing machinery, and crop-production machinery. Investigations on mechanical processing of farm products covered ginning and packing of cotton and fiber-flax processing. Rural electrification research and regional research laboratories are also reported upon briefly.

RAPID INCREASE IN IRRIGATION WELLS PROMPTS SURVEY BY STATION, *W. E. Code*. Colo. Farm Bul., Colorado Agrl. Exp. Sta. (Fort Collins), 3 (1941), no. 1, pp. 7-8. This brief article calls attention to the rapid increase in irrigation pumping, brought about by drought demands and the presence of cheap electric power, and explains that the survey work of the station during the past 12 years has been undertaken for the purpose of developing efficient utilization of the water resources of the state and not to bring about any unnecessary restrictive legislation.

WATER SUPPLY AND SEWAGE INVESTIGATIONS [AT THE NEW JERSEY STATIONS]. New Jersey Agrl. Exp. Stas. (New Brunswick), Rpt. 1940, pp. 105-107, fig. 1. These are briefly summarized under the following captions: Can copper or brass piping always be used for household water supplies? Is there a standard chemical procedure for the treatment of sewage? What is the activated sludge process of sewage treatment? Is the sewage received from a given system always uniform in character? Is there any way of reducing the size of the sedimentation tanks which take up so much space and represent so much of the capital outlay involved in building a sewage treatment plant? Cannot the industries of this state be compelled to cease polluting our waters? Are the results of investigations in water and sewage problems being applied for the benefit of other departments in the State?

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE CORNELL STATION. New York (Cornell) Agrl. Exp. Sta. (Ithaca), Rpt. 1940, pp. 91-92. Improvements in the design of farm-power machinery are briefly discussed by B. A. Jennings and F. W. Barrett, who have designed and constructed a grain-drill arrangement for planting peas and beans with side-band fertilizer placement and hoe openers for the seed so spaced as to avoid fouling, a corn planter having three seed hoppers on a grain-drill frame with provision for side-band fertilizer placement, and an improved tractor-potato digger hitch. Completion of the work on brooding-equipment tests and design is reported by P. R. Hoff and C. E. Lee. Other projects listed are under the direction of J. C. McCurdy, B. B. Robb, and J. P. Porter (with A. H. Sayer); H. W. Riley; and H. S. Pringle.

TURPENTINE STILL BUILDINGS AND EQUIPMENT. U. S. Dept. Agr. (Washington), Misc. Pub. 387 (1940), pp. [2]+44, figs. 35. This publication contains specifications, working drawings, and bills of materials for still buildings including ramp, for a copper fire still for turpentine, and for a still worm to be attached to this still. Directions for setting the fire still are given in addition to the drawings. Condenser tub, separators, dehydrators, rosin vats, and a cooper's winch are also taken up. Working drawings for these accessories are included. *(Continued on page 376)*

Agricultural Engineering Digest

(Continued from page 374)

AGRICULTURAL ENGINEERING INVESTIGATIONS AT THE OKLAHOMA STATION. (Partly coop. U.S.D.A.) Oklahoma Agrl. Exp. Sta. (Stillwater) Bien. Rpt. 1939-40, p. 25. Studies by M. Cox on the ability of grasses to protect terrace outlet channels and by L. E. Hazen on subsurface outlets are briefly noted.

Literature Received

"380 THINGS TO MAKE FOR FARM AND HOME," by Glen C. Cook, assistant professor of education, Michigan State College. Cloth, 6x9 inches, 325 pages, 388 figures. $2.50. The Interstate, Danville, Ill. The purpose of this book is to furnish a comprehensive list of shop projects needed on the farm and in the farm home. The primary aim has been to select a practical list of plans and ideas which have been tested and proved successful for use by farmers, teachers of vocational agriculture, teachers of general shop, high school students, county agricultural agents, college agricultural engineering departments, and other interested in shop activity.

EMPLOYMENT BULLETIN

The American Society of Agricultural Engineers conducts an employment service especially for the benefit of its members. Only Society members in good standing may insert notices under "Positions Wanted," or apply for positions under "Positions Open." Both non-members and members seeking to fill positions, for which ASAE members are qualified, are privileged to insert notices under "Positions Open," and to be referred to members listed under "Positions Wanted." Any notice in this bulletin will be inserted once and will thereafter be discontinued, unless additional insertions are requested. There is no charge for notices published in this bulletin. Requests for insertions should be addressed to ASAE, St. Joseph, Michigan.

POSITIONS OPEN

AGRICULTURAL ENGINEER wanted for farm structures research work in the agricultural experiment station of a southeastern college. Only a man with some research experience and not subject to immediate military service will be considered. Work will be primarily concerned with storage buildings. Good fundamental training with good scholastic records necessary. Salary up to $2,700 according to qualifications. PO-134

ENGINEER wanted at once to take charge of development work and all engineering in a rapidly expanding foundry and manufacturing farm machinery organization in Wisconsin. Must be experienced. Real opportunity for man who can accept responsibility. Young man preferred—one willing to live in a small town, home of plant. Write for full details to R. C. Breth, Inc., Advertising Counsel, Green Bay, Wis.

ENGINEERS needed by U. S. Government. The U. S. Civil Service Commission, Washington, D. C., has listed the following opportunities for engineering work for the federal government, of possible interest to A.S.A.E. members:

Engineering Aides (Five grades, $1620 to $2600). Unassembled examination. Write for announcement No. 120.

Engineering Draftsmen (Five grades, $1620 to $2600). Unassembled examination. Write for announcement No. 28.

Junior Engineers ($2000). Unassembled examination. Write for announcement No. 51.

Engineers (Five grades, $2600 to $5600). Unassembled examination. Write for announcement No. 69.

Research Chemists (Five grades, $2600 to $5600). Unassembled examination. Write for announcement No. 58.

Chemists (Explosives) (Five grades, $2600 to $5600). Unassembled examination. Write for announcement No. 2.

Technologists (Any specialized branch; five grades, $2600 to $5600). Unassembled examination. Write for announcement No. 10.

Copies of the announcements referred to may be obtained by writing direct to the Commission. They give full details concerning the positions, the requirements to be met, and where to obtain and file applications.

POSITIONS WANTED

AGRICULTURAL ENGINEER, also farm and supply manager, has had 20 years' experience in agricultural pursuits as manager of large farming enterprise and agricultural supply house, and as chief agricultural engineer of large irrigation development in the West. Has had technical training and practical experience in all phases of engineering and agricultural production, development, and marketing. Best of references. Forty-four years of age. Married. PW-341